APPENDIX A

PUBLIC COMMENTS

PART 2 OF 4

ALL PERSONALLY IDENTIFYABLE INFORMATION OF PRIVATE CITIZENS, EXCEPT ACTING IN A PROFESSIONAL CAPACITY, HAS BEEN REDACTED IN ACCORDANCE WITH LR 8.1(a)

Comment A-123
Part 1

GOVERNMENT ACCOUNTABILITY PROJECT

1612 K Street NW Suite #808
Washington, DC, 20006
(202) 457-0034
whistleblower.org

August 1, 2024

Assistant Attorney General
Environment and Natural Resources Division
U.S. Department of Justice
950 Pennsylvania Avenue, NW
Washington, DC 20530-0001

RE: State of Ohio and United States of America v. Norfolk Southern Railway Company, et al., Case No. 4:23-cv-00517, D.J. Ref. No. 90-11-3-12792

Dear Assistant Attorney General,

Government Accountability Project, the nation's leading whistleblower protection organization since 1977, represents protected whistleblowers who have raised concerns about the response to the February 3, 2023 East Palestine train derailment, and has been investigating the disaster and its outcome since July 2023. Based on our clients' disclosures and our investigative findings, we strongly object to the proposed Consent Decree entered on May 23, 2024 in the case of *State of Ohio and United States of America v. Norfolk Southern Railway Company, et al.*, D.J. Ref. No. 90-11-3-12792.

While the proposed $310 million settlement outlines various penalties and remediation measures, it falls short of addressing the full scope of the damage and ongoing health crises faced by the residents of East Palestine, Ohio, and other impacted communities following the train derailment and open burn of train car chemicals.

For nearly a year, we have interviewed impacted residents, independent scientists, toxicology experts, researchers and protected whistleblowers and have unearthed documents that collectively reveal significant oversights and failings by the Environmental Protection Agency (EPA) that must be adequately addressed in the current proposal.

It is imperative to consider the complete body of evidence based on the reality for residents' lives before finalizing this settlement. To that end, please find our enclosed exhibit compilation which contains both publicly available documents and investigative work product work products not publicly available until June 27, 2024. Therefore, most of these materials, which are highly relevant to the proposed settlement, could not have been taken under advisement by the Department of Justice in crafting the proposed settlement. Further, through this comment we are releasing eight additional signed statements for your consideration.

Further, the consent decree was drafted a month prior to the conclusion of a crucial National Transportation Safety Board (NTSB) investigation that revealed Norfolk Southern wrongdoing that could potentially lead to additional civil penalties and/or criminal charges. The NTSB's final hearing on June 25, 2024 revealed that Norfolk Southern failed to convey critical information to

decision makers that could have prevented the vent and burn of five vinyl chloride train cars.[1] Additionally, NTSB Chair Jennifer Homendy announced at the hearing that Norfolk Southern repeatedly failed to cooperate with NTSB investigators and even threatened her staff.[2]

Among the critical points supported in our exhibits are:

1. Dioxin Contamination: Documents discovered a year after the train derailment reveal that the EPA was aware of dangerously high dioxin levels at the derailment site as early as February 17, 2023, yet delayed community testing a month after the derailment under the guise that dioxin was not a concern (Exhibits 28-29). Norfolk Southern contractor Arcadis eventually began a soil sampling plan in the community, but that plan was criticized by dioxin expert Dr. Stephen Lester (Exhibit 20).

2. Ongoing Environmental and Health Hazards: Independent tests have detected elevated levels of dioxins, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) in the environment, including highly elevated dioxin levels in garden crops and elevated PAH contamination in creeks (Exhibits 6, 41, 58, 61-62). In fact, recent news reports revealed that EPA found pockets of vinyl chloride in the community but failed to notify the public until after being questioned by reporters (Exhibit 44, 51, 56).

3. Ongoing EPA watchdog investigations: Following the May 14, 2024 disclosure from Government Accountability Project whistleblower Dr. Robert Kroutil, the EPA Office of Inspector General on July 16, 2024 announced it was opening an investigation into the EPA's use of the ASPECT aircraft in East Palestine.[3] The outcome of this investigation could shed light on EPA's failure to collect critical chemical data in East Palestine, but findings impacting the equity of the proposed settlement may be months away. Protected whistleblower disclosures of Dr. Kroutil, a former EPA contractor, highlight the EPA's failure to deploy the ASPECT aircraft, its best chemical sensing technology, in a timely manner. This delay and subsequent sensor deactivation over contaminated areas indicate a significant lack of transparency and accountability and a dearth of missing data that makes assessing the extent of harm to the health and environment impossible.

4. Health Impacts on Residents: Residents continue to suffer from severe health issues, including rashes, seizures, and new cancers (Exhibits 32, 36). Affidavits collected by Government Accountability Project attest to these ongoing health nightmares (Exhibits 63, 64, 65, 66, 67, 68, 69, 70). Many of these health impacts will not be addressed by the

[1] Bense, Kiley. "NTSB Says Norfolk Southern Threatened Staff as They Investigated the East Palestine Derailment." Mother Jones, July 1, 2024. http://www.motherjones.com/environment/2024/07/ntsb-says-norfolk-southern-threatened-staff-as-they-investigated-the-east-palestine-derailment/.
[2] Ibid.
[3] Kroutil, Robert. "Whistleblower: EPA Failed to Deploy Critical Airborne Technology During East Palestine Disaster." Government Accountability Project, May 14, 2024. http://whistleblower.org/press-release/whistleblower-epa-failed-to-deploy-critical-airborne-technology-during-east-palestine-disaster/.

proposed $25 million community health program as patients in the health program will have to seek outside care from specialists not available at the clinics.[4]

5. Inadequate Penalties: We agree with impacted residents that the $15 million civil penalty for violating the Clean Water Act is insufficient to address the extensive damage to local waterways, due to the unauthorized discharge of pollutants and hazardous substances to U.S. waters including East Palestine creeks Sulphur and Leslie Runs, Little Beaver Creek, and downstream impacts on the Ohio River and groundwater in the region.[5] These waterways continue to show evidence of continued contamination to the present.[6] Therefore, the settlement must impose stricter penalties and comprehensive remediation measures. Additionally, the damage to groundwater from the derailment has not yet been fully assessed. A new study released in June after the proposed federal settlement was announced, revealing that toxic plumes from the derailment open burn impacted 16 states as well as Canada.[7]

6. Funds for Health Monitoring: The $25 million allotment over 20 years for a community health program is inadequate to meet community members' needs. Funding for medical exams could be depleted in far fewer than 20 years.

Divided over 20 years, $25 million equates to $1.25 million annually for the program. According to U.S. Census data, approximately 4,723 people residents live in East Palestine.[8] However, individuals qualified to receive medical monitoring exams under the proposed settlement include nearly 11,000 residents who live within the eligible two-mile radius of the train derailment.[9] Additionally, an unknown number of residents living within 250 feet from the centerline in both directions of Leslie Run from the confluence of Sulphur Run to the confluence of Bull Run are eligible for medical monitoring exams as well as first responders, including approximately 300 firefighters from 50 departments. The settlement also includes other individuals admitted on a case-by-case basis. Based on 11,000 residents alone, it appears that roughly only $114 per year is available for each eligible resident to participate in the Norfolk Southern health exam program.

Furthermore, medical monitoring exams are mandated for 15 years, and if the funding is exhausted by the 14th anniversary of the 20-year Community Health Program, Norfolk

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[4] United States District Court for the Northern District of Ohio Eastern Division, "Consent Decree between United States of America, The State of Ohio v. Norfolk Southern Railway Company and Norfolk Southern Railway," Case No. 4:23-cv-00517-JRA, filed May 23, 2024. http://www.justice.gov/enrd/media/1353111/dl?inline.

[5] Bense, Kiley. "East Palestine Train Derailment Settlements." Inside Climate News, June 5, 2024. http://insideclimatenews.org/news/05062024/east-palestine-train-derailment-settlements/.

[6] McHugh, Rich. "Ohio Train Derailment: East Palestine Creeks Still Visibly Contaminated," News Nation, February 2, 2024, https://www.newsnationnow.com/us-news/midwest/ohio-train-derailment/ohio-train-derailment-east-palestine-creeks-still-visibly-contaminated/.

[7] Thompson, Jess. "Maps Reveal Pollution Fallout From Ohio Train Derailment—With 16 States Hit." Newsweek, June 19, 2024. http://www.newsweek.com/ohio-train-derailment-chemical-pollution-maps-1914972.

[8] "East Palestine, OH." Census Reporter. Accessed July 19, 2024. http://censusreporter.org/profiles/16000US3923940-east-palestine-oh/.

[9] UrbanFootprint. "East Palestine Impacts Mapped." UrbanFootprint (blog). April 4, 2023. http://urbanfootprint.com/blog/blog-post/east-palestine-impacts-mapped/.

Southern "may seek termination of their obligations under this Section pursuant to Section 48 (Termination)."[10]

It does not appear that the community health program considers the real-world costs associated with medical care for residents, their children and offspring, which could be in the tens of thousands of dollars per resident, especially if they develop chronic illness such as cancer or multigenerational impacts such as birth defects. The medical monitoring exams include routine physical examination; comprehensive metabolic blood panel; pulmonary function tests; x-rays; assessment of results and additional screenings the parties agree upon. However, the program does not cover the cost of a specialist and instead offers referrals to a specialist as warranted based on the exam.[11]

Moreover, the odds of needing medical specialists could rise with ongoing, chronic exposure to dioxin and other dangerous chemicals as evidenced by previous environmental disasters.[12]

This is why residents need lifetime medical monitoring as well as Medicare for life akin to what was offered to World Trade Center responders. By contrast, the September 11 Victim Compensation Fund program is authorized to continue until 2090, ensuring long-term healthcare and medical monitoring for exposed individuals.[13]

The recent and emerging evidence, including exhibits detailing EPA misfeasance and a lack of transparency, calls for a reevaluation of the proposed settlement. Norfolk Southern must be held accountable not only through financial penalties but also by ensuring the health and safety of the affected residents. This should include lifelong medical monitoring and care, funding for the permanent relocation of residents suffering from ongoing health issues, and reconsideration of potential criminal charges against Norfolk Southern given new information about the company's failure to convey critical information to key decision makers that could have prevented the open burn of hazardous materials.[14]

Enclosed, please find the results of Government Accountability Project's detailed investigation and White House Briefing Packet on East Palestine, which I urge you to review thoroughly. It is crucial that all evidence is considered to ensure a just and comprehensive resolution to this disaster.

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[10] United States District Court for the Northern District of Ohio Eastern Division, "Consent Decree between United States of America, The State of Ohio v. Norfolk Southern Railway Company and Norfolk Southern Railway," Case No. 4:23-cv-00517-JRA, filed May 23, 2024. http://www.justice.gov/enrd/media/1353111/dl?inline.

[11] United States District Court for the Northern District of Ohio Eastern Division, "Consent Decree between United States of America, The State of Ohio v. Norfolk Southern Railway Company and Norfolk Southern Railway," Case No. 4:23-cv-00517-JRA, filed May 23, 2024. http://www.justice.gov/enrd/media/1353111/dl?inline.

[12] Devine, Tom and Lesley Pacey. "Fourth Installment of BP Deepwater Horizon Disaster Report Reveals Terrifying Consequences of Cleanup Chemical Corexit." Government Accountability Project, April 18, 2024. http://www.whistleblower.org/press-release/fourth-installment-of-bp-deepwater-horizon-disaster-report-reveals-terrifying-consequences-of-cleanup-chemical-corexit/.

[13] September 11th Victim Compensation Fund. Accessed July 19, 2024. http://www.vcf.gov.

[14] National Transportation Safety Board. Investigative Hearing: Norfolk Southern Railway Train Derailment with Subsequent Hazardous Material Release and Fires. June 22-23, 2024. https://www.ntsb.gov/news/events/Pages/East-Palestine-Hearing-Event.aspx; Department of Justice. Federal Environmental Crimes, by Statute. Accessed July 25, 2024. https://www.justice.gov/enrd/federal-environmental-crimes-statute.

Thank you for your attention to this urgent matter.

Sincerely,

/s/ Lesley Pacey

Lesley Pacey
Senior Environmental Officer
Government Accountability Project
1612 K Street NS, Suite 808
Washington, DC 20006
lesleyp@whistleblower.org
251-990-3515

Enclosures: Government Accountability Project Investigation Exhibit Set

Government Accountability Project East Palestine Investigation

EXHIBIT INDEX

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Exhibits

EXHIBIT 1

[redacted]

On Wednesday, March 8, 2023, 9:11 AM, Nancy Alderman [redacted] wrote:

February 8, 2023

Good Morning [redacted],

I have now spoken to Dr. Chang. He is from CDC and he was sent to East Palestine to help people understand what the government agencies have found, and try to alleviate people's fears and anxieties. He advised me to go ahead and give you our opinions – so that is what I am now doing.

I will give you our thoughts.

First mine: My name is Nancy Alderman, and I am President of Environment and Human Health, Inc. (EHHI) which is a group of 11 physicians and public health professionals who work to protect the public from environmental harms.

Then history of environmental disasters lays out what happens in many of these cases. Government comes in and tries to calm the situation down and starts testing. However, what we have learned from Love Canal, Chernobyl, the huge oil spill in the Gulf, (where people worked to clean up the oil), is that the full amount of the damage to the environment and to people's health is not known for a number of years. It takes a long time to fully understand the scope of these disasters and exactly what they have cause to people's health and to the surrounding landscape including drinking water supplies.

[redacted]

[redacted] [redacted]

No one can possibly know whether it is really safe right now to live and work in the areas that were/are affected by the East Palestine train wreck. This means it is often prudent to act now rather than waiting. In the case of East Palestine, it is known what chemicals were on the train cars that crashed, and most of those chemicals are well known enough to know their environmental and health hazards.

From our Board

In situations such as this the advice to stay put and wait for the science makes little sense. The presumption of hazard is the only ethical conclusion to reach. With most hazardous sites and spills, the evidence is rarely available to conclude danger or safety. EPA's expression of safety seems unfounded to me. With most other sites (Superfund, RCRA, and spill areas) the only reassurance comes from long term testing of air (indoors and outside) soils, ground and drinking water, and foods. Human tissue testing is also essential to test for the suite of chemicals released.

Long term medical surveillance of humans, pets, livestock is essential to reach a responsible determination of safety, and to understand the probabilities of illness causation. This situation reminds me of the political fight over the evacuation boundary surrounding the Chernobyl and Fukushima accident sites being so conflicted due to the extraordinary costs of pursuing the precautionary actions suggested above under such conditions of uncertainty.

Here is a list of EHHI's Board members and its website – https://www.ehhi.org

Susan S. Addiss, MPH, MUrS. Past Commissioner of Health for the State of Connecticut; Past President of the American Public Health Association; Past member of the Pew Environmental Health Commission; Vice-Chair, Connecticut Health Foundation Board; Past President, CT Association of Directors of Health.

Nancy O. Alderman, MES. President of Environment and Human Health, Inc.; Past member of the Governor's Pollution Prevention Task Force; Past member of the National Board of Environmental Defense; Recipient of the CT Bar Association, Environmental Law Section's,

Clyde Fisher Award, given in recognition of significant contributions to the preservation of environmental quality through work in the fields of environmental law, environmental protection or environmental planning, and the New England Public Health Association's Robert C. Huestis/Eric Mood Award given to individuals for outstanding contributions to public health in the environmental health area.

Gaboury Benoit, Ph.D. The Grinstein Professor of Environmental Chemistry at Yale University's School of Forestry and Environmental Studies; Director of the Hixon Center for Urban Ecology; Published more than 70 peer-reviewed articles on heavy metals and nonpoint source pollution; Co-author of the books *The Land and Natural Development (L.A.N.D.) Code* (Wiley) and *New Strategies for America's Watersheds* (National Academy Press)

D. Barry Boyd, MD. Clinical Professor of Medicine, Yale University School of Medicine, Oncologist at Greenwich Hospital and Affiliate Member of the Yale Cancer Center. Research areas include environmental risk factors for cancer as well as cancer etiology, including nutrition and the role of insulin and IGF in malignancy. Dr. Boyd is the Founder and Director of Integrative Medicine at Greenwich Hospital — Yale Health System.

David R. Brown, Sc.D. Public Health Toxicologist and Director of Public Health Toxicology for Environment and Human Health, Inc.; Past Chief of Environmental Epidemiology and Occupational Health at Connecticut's Department of Health; Past Deputy Director of The Public Health Practice Group of ATSDR at the National Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia.

Thomas F. Harrison, Esq. Connecticut Environmental Lawyer; Past Assistant Attorney General in the New York State's Attorney General's office; Past Regional Counsel in the largest U.S. EPA Office, Region 5; Past Senior Corporate Council to the BFGoodrich Company; Past Partner at the Hartford law firm of Day Pitney LLP; Served on Connecticut's Board of Contracting Standards and Review; Served on the CT Council of Environmental Quality and was the Past Chairman of the Environmental Section of the CT Bar Association.

Pinar H. Kodaman, MD, PhD. Associate Professor of Obstetrics, Gynecology, and Reproductive Sciences, Division of Reproductive

[redacted]

[redacted] [redacted]

Endocrinology and Infertility, Yale University School of Medicine; Director of the Early Recurrent Pregnancy Loss Program at the Yale Fertility Center.

Barbara S. Miller, Esq. Senior Counsel and past partner at the Southport, Connecticut law firm of Brody Wilkinson PC; Past member of the Executive Committee of the Environmental Law Section of the Connecticut Bar Association; Member, Board of Directors of the Connecticut Zoological Society, Inc.; Past Vice-President of the Connecticut Fund for the Environment, Inc.; Past Chair of the Connecticut Audubon Society Coastal Center Board of Directors.

Sarah S. Mougalian, MD. Associate Professor of Medicine, Oncology, with a focus on Breast Medical Oncology, Smilow Cancer Center, Yale University School of Medicine. Ambulatory Floor Chief, Breast and Gynecologic Oncology, Smilow Cancer Hospital. Recipient of many awards including the Clifton Howe Award given for clinical excellence to a medical oncology fellow.

William Petit, Jr., MD. Board certified in diabetes, metabolism and endocrinology; Former Director of the Joslin Diabetes Center and Director of clinical research at The Hospital of Central Connecticut; Past President of the Hartford County Medical Association and Past Council Chair of the Connecticut State Medical Society; Former State Representative and ranking member of the CT Public Health Committee, Energy & Technology, and Appropriations committees; Past Plainville Director of Public Health.

Hugh S. Taylor, M.D. Anita O'Keeffe Young Professor and Chair of the Department of Obstetrics, Gynecology and Reproductive Sciences and Department of Molecular, Cellular and Developmental Biology, Yale University School of Medicine; Chief of Obstetrics and Gynecology at Yale-New Haven Hospital.

John P. Wargo, Ph.D. Tweedy Ordway Professor of Environmental Health and Politics, Yale University's School of Forestry and Environmental Studies, and Professor of Political Science. Author of *Green Intelligence: Creating Environments That Protect Human Health* published by Yale Press. The book won the Independent Publishers Award of Gold Medal in the field of "environment, ecology, and nature" for 2010. It also won the 2010 Connecticut Book Award in

[redacted]

non-fiction. It was chosen as one of Scientific American's favorite books for 2009. Also author of *Our Children's Toxic Legacy*, which won the American Association Publisher's competition as best scholarly and professional book in an area of government and political science in 1997.

EXHIBIT 2

United States Senate

WASHINGTON, DC 20510

February 18, 2023

Ms. Anne Vogel
Director
Ohio Environmental Protection Agency
PO Box 1049
Columbus, OH 43216

The Honorable Michael S. Regan
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Dear Director Vogel and Administrator Michael Regan:

We write regarding the February 3, 2023 Norfolk Southern train derailment near the Ohio-Pennsylvania border in East Palestine, Ohio and to inquire about the scope of monitoring in East Palestine and the surrounding communities. Specifically, we request additional information regarding the Ohio Environmental Protection Agency (OEPA)'s and the U.S. Environmental Protection Agency (EPA)'s plans to monitor East Palestine and the surrounding area for dioxins.

We appreciate the swift responses both of your agencies have executed in response to this crisis, and for the assistance to local authorities and residents. We also appreciate the extensive air monitoring U.S. EPA has undertaken related to vinyl chloride and several known by-products that are produced when vinyl chloride burns including phosgene and hydrogen chloride. However, following our visits to East Palestine this past week where we heard directly from members of the community, we remain concerned that it does not appear that the U.S. EPA, OEPA, or Norfolk Southern is texting for dioxins.

The combustion of vinyl chloride can lead to the formation of dioxins. Dioxins are a group of compounds that are persistent environmental pollutants known to bioaccumulate in animals and humans. According to the U.S. EPA, dioxins are highly toxic, can interfere with hormones, and can cause cancer, reproductive and developmental problems, or damage to the immune system.[1] We are concerned that that the burning of large volumes of vinyl chloride may have resulted in the formation of dioxins that may have been dispersed throughout the East Palestine community and potentially a much large area.

[1] https://www.epa.gov/dioxin/learn-about-dioxin

In response to this incident, we ask that you provide clarifying answers to the following questions by Friday, February 24th.

1. Has either the OEPA and/or U.S. EPA been monitoring the air for dioxins?
2. If not, please explain why the OEPA and/or U.S. EPA has not been monitoring for dioxins?
3. Is the OEPA or U.S. EPA aware of any other entity that may be monitoring for dioxins, including Norfolk Southern?
4. Are there additional resources or authorities that OEPA or U.S. EPA needs in order to undertake regular monitoring for dioxins in East Palestine and the surrounding community?
5. Does OEPA or U.S. EPA have a system set up for members of the community and other expert stakeholders to engage on the testing and monitoring regimen following the train derailment and subsequent activities in East Palestine to ensure a thorough, comprehensive response to monitor the area for potential pollutants? If not, will you commit to establishing appropriate protocol to ensure engagement?
6. If dioxins are detected in the region, what are OEPA's and U.S. EPA's respective protocols for communicating with the local community, addressing the potential contaminant(s), and protecting the local community from potential long-term exposure?

We urge OEPA and U.S. EPA to act immediately to coordinate and ensure regular testing and monitoring for dioxins remains a priority moving forward. This monitoring should not only be a part of a long-term strategy, it should be implemented immediately and communicated to the local community to ensure transparency.

If there's anything we can do to help ensure OEPA and U.S. EPA have the resources and support necessary to ensure thorough testing for dioxins, in addition to the other air, soil, and water sampling U.S. EPA is conducting, please do not hesitate to ask. We remain committed to supporting your work protecting the public health.

Thank you for your prompt attention to this critical matter.

Sincerely,

Sherrod Brown
United States Senator

JD Vance
United States Senator

EXHIBIT 3


BUCKEYE ENVIRONMENTAL NETWORK
Ohio Farmers Union
River Valley ORGANIZING
Ohio Environmental Council
FreshWater ACCOUNTABILITY PROJECT
DIRECTIONS OF SERVICE
PASUP
ACCAN
RADIOACTIVE WASTE ALERT
Athens County's Future Action Network aka ACFAN and Athens County Fracking Action Network
CLEAN AIR COUNCIL
BC•MAC
Beaver County Marcellus Awareness Community
BREATHE PROJECT
Cancer & Environment Network of Southwestern Pennsylvania
The Climate Reality Project
ENVIRONMENTAL HEALTH PROJECT
FRACTRACKER ALLIANCE
GREENSCIENCE
YOUGHIOGHENY RIVERKEEPER
Move Past Plastic
Protect PT
PennFuture
RAPPP
SISTERS OF ST. JOSEPH
THREE RIVERS WATERKEEPER
UNITED STEELWORKERS USW
WOMEN for a Healthy ENVIRONMENT
ACAT
Alaska Community Action on Toxics
air ALLIANCE
BAYOU CITY WATERKEEPER
bcpp Breast Cancer Prevention Partners
BEYOND PLASTICS
BEAT
CEH
BLACK WOMEN FOR WELLNESS
Californians Against Waste
Alliance of Nurses for Healthy Environments
Alianza Nacional De Campesinas Inc.
CLEAN COALITION
CLEAN CAPE FEAR
DEFEND OUR HEALTH
CAAN
cpaf CLEAN PRODUCTION ACTION
CLEAN WATER ACTION
50 YEARS
CHE Collaborative for Health & Environment
CIEL CENTER for INTERNATIONAL ENVIRONMENTAL LAW
EARTHJUSTICE
ECOLOGYCENTER
Friends of the Earth
FENCELINE WATCH
FRESHWATER FUTURE
Green America
GRASSROOTS ENVIRONMENTAL EDUCATION
GREATER NORTHFIELD WATERSHED ASSOCIATION
LCV
MADE SAFE
MATERIAL RESEARCH ATLAS OF TOXIC CHEMICAL PRODUCTION
MERRIMACK CITIZENS FOR CLEAN WATER
MOMS clean air FORCE
MOMS NON-TOXIC NEW YORK
just zero
National Nurses United
National Toxic Encephalopathy Foundation
GREENPEACE
ICTA
No Fracked Gas in Mass
Northeast Organic Farming Association
nofa
MOMS ACROSS AMERICA
oec Oregon Environmental Council
river NETWORK connecting people saving rivers
SCIENCE & ENVIRONMENTAL HEALTH NETWORK
plasticpollutioncoalition
second look
SIERRA CLUB
safer states
t.e.j.a.s Texas Environmental Justice Advocacy Services
The Last Plastic Straw
THE STORY OF STUFF PROJECT
WVE
WE ACT FOR ENVIRONMENTAL JUSTICE
THE LAST BEACH CLEANUP
RAILROAD WORKERS UNITED
SLINGSHOT
Toxic-Free FUTURE
Until Justice Data Partners, Inc.
VNRC
WOMEN ENGAGED NETWORK
TOXIC FREE NC

Michael Regan, EPA Administrator
Janet McCabe, Deputy Administrator
Debra Shore, EPA Region 5 Administrator
Adam Ortiz, EPA Region 3 Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., N.W.
Washington, DC 20460

March 13, 2023

RE: Dioxins and the East Palestine Train Derailment

Dear Administrator Regan, Deputy Administrator McCabe, Regional Administrator Shore, and Regional Administrator Ortiz:

Although delayed, we welcome the U.S. Environmental Protection Agency (EPA)'s announcement on March 2, 2023 that it will now require Norfolk Southern to test for dioxins in the areas impacted by the East Palestine train derailment. We are writing to share our recommendations on how this testing should be conducted to improve transparency, rebuild public trust, and comprehensively address possible releases of dioxins from the disaster. We join Senators Sherrod Brown (D-OH) and J. D. Vance (R-OH) in urging EPA to require thorough testing for dioxins.

As you know, dioxins are extremely persistent bioaccumulative toxic (PBT) chemicals that break down very slowly, build up in the food chain and in our bodies, and can cause cancer and other serious health problems. In the EPA's own words, "Dioxins are highly toxic and can cause cancer, reproductive and developmental problems, damage to the immune system, and can interfere with hormones." Indeed, dioxins are one of the most toxic chemicals known to humankind and have been targeted for global phase-out under the POPS Treaty. It was the primary contaminant in Agent Orange, the defoliant used in Vietnam, and a key contaminant at both Love Canal and Times Beach.

EPA must lead the dioxin sampling, not Norfolk Southern.

To date, Norfolk Southern has done an extremely poor job of building trust with the community of East Palestine and other communities impacted by the disaster. To ensure this testing is adequately conducted, and to rebuild public trust, we strongly recommend the U.S. EPA itself conduct the dioxin sampling or hire its own consultants to conduct the testing. Norfolk Southern should not be in charge of the dioxin sampling. This testing must be paid for by the responsible parties, not taxpayers.

The dioxin sampling plan must be transparent and released for public input.

Without comprehensive testing, the people in East Palestine and other communities in Ohio and Pennsylvania will not know the extent to which dioxins are an issue. To build trust and confidence in the results, a transparent process for developing a sampling plan needs to be the next step. The sampling plan must identify and state:

- Goals and objective of the sampling plan;
- What environmental media – soil, dust, animals, water, sediment, air – will be sampled;
- Sample locations for each medium type; It must include communities that were in the path of the plume.
- The number of samples that will be collected for each medium type;

- Sample collection procedures for each medium type;
- Detection limits for each medium type;
- Analytical procedures for each medium type;
- Which suite of dioxins will be analyzed. Total polychlorinated dioxins and furans should be measured as well as PCBs, especially the dioxin-like PCBs;
- Details on quality control/quality assurance procedures; and
- What analytical laboratory will analyze the samples.

The proposed sampling plan should be made public and given to area residents to review and comment on before the testing begins.

All sampling data and test results should be made available to the public for review in a transparent and easily accessible format. This information must be accessible for review, given the need for results to be meaningful to impacted communities as well as to build trust through transparent action.

The dioxin sampling plan must be comprehensive.

Responders reportedly punctured and burned more than 115,000 gallons of vinyl chloride in uncontrolled conditions for numerous days, making it likely that dioxins and related chlorinated substances were formed and released into the communities surrounding the disaster site. Four train cars of polyvinyl chloride plastic also burned, also likely forming dioxins. There have been elevated levels of dioxins released in other major accidents involving chlorinated chemicals—from the 2004 explosion at the PVC plant in Illiopolis, Illinois, to the 1997 Plastimet PVC recycling fire in Ontario, to the 2001 World Trade Center attacks. A study of a European train carrying vinyl chloride that derailed and burned found background dioxin values measured in soils and plants generally in the range of 20 ng TEQ/kg in the surrounding area but increased to 8300 ng at the very seat of the fire. Producers of PVC and vinyl chloride monomer report releasing dioxins. Oxy Vinyls' vinyl chloride monomer (VCM) plant in Texas reported the greatest releases of dioxins compared to any other facility in the country, according to the EPA 2021 TRI dioxin factsheet.

The EPA must work to evaluate whether elevated levels of dioxins may have been released and contaminated various environmental media, not just soil. **The EPA must develop a comprehensive multimedia testing program into the possible release of dioxins, other chlorinated ring compounds, and other toxic byproducts from the disaster.** We recommend sampling for dioxin and other chlorinated ring compounds (such as chlorinated PAHs) is conducted:

- In soils at homes, parks, schools, farms, and other locations downwind of the derailment;
- In indoor dust and surfaces inside homes and other buildings downwind of the derailment;
- In farm animals, milk, and chicken eggs in farms that may be impacted by the derailment; and
- In sediments, fish, salamanders (e.g. endangered Hellbender salamanders in OH), and other aquatic life including vegetation.
- In wildlife in the area, including birds and deer, which may be hunted

We are concerned that EPA may be overly reliant on samples for "indicator chemicals" such as chlorobenzenes and chlorophenols. In its March 2nd press release, EPA stated that: "monitoring for indicator chemicals has suggested a low probability for release of dioxin from this incident." This is concerning for a few reasons. According to the EPA's website, Soil and Sediment Sampling Data: East Palestine, Ohio Train Derailment | US EPA, the reporting limit for chlorophenols (and dibenzofurans, a close relative of dioxins) is 53-65 mg/kg of soil or sediment. For chlorobenzenes, the reporting limit is

much lower at 0.05-0.06 mg/kg. As EPA scientists are undoubtedly aware, chlorobenzenes are much more volatile than chlorophenols or dioxins. So, we would expect that any chlorobenzenes that formed would have evaporated from the soil. Dioxins, however, are persistent in soil and sediments and are toxic at extremely low levels. EPA's soil screening level for dioxin is 1 ppb and the EPA has previously proposed stringent preliminary remediation goals (PRGs) for dioxins at contaminated sites at 72 PPT TEQ for residential soil (for non-cancer effects) and were also considering 3.7 PPT TEQ for residential soil (for cancer effects). We need soil/sediment testing in E Palestine at much lower levels of detection than 50-60 mg/kg.

Finally, we recommend the EPA work with other agencies to provide medical monitoring for impacted communities, especially East Palestine and those in the combustion plume, that desire it.

Communities surrounding and downwind of the derailment have a right to know whether the fire resulted in elevated concentrations of dioxins. The testing must be transparent and comprehensive. This would help demonstrate EPA's commitment to comprehensively responding to this disaster, rebuilding trust with East Palestine and other impacted communities, and advancing environmental justice.

We request an opportunity to meet with you. Please contact Mike Schade at mschade@toxicfreefuture.org / 646.783.3477 to arrange a mutually convenient time.

Sincerely,

Amanda Kiger, Executive Director
River Valley Organizing
Ohio

Mardy Townsend, President
Ashtabula, Geauga, Lake Counties Farmers Union
Ohio

Heather Cantino, Steering Committee Chair
Athens County's Future Action Network, acfan.org
Ohio

Zach BollheimerInterim, Executive Director
Buckeye Environmental Network
Ohio

Margaret Mills, President of the Board
FaCT - Faith Communities Together for a Sustainable Future
Ohio

Lea Harper, Managing Director, FreshWater Accountability Project
Ohio

Melanie Houston, Managing Director of Water Policy,
Ohio Environmental Council
Ohio

Joe Logan, President
Ohio Farmers Union
Ohio

Rex Dickey
Ohio Residents Concerned about East Palestine Accident
Ohio

Jill Hunkler, Director
Ohio Valley Allies
Ohio

Carolyn Harding, Organizer
RadioactiveWasteAlert.org
Ohio

Barbara Pace, Board
Allegheny County Clean Air Now
Pennsylvania

Nora Johnson, Secretary
Beaver County Marcellus Awareness Community (BCMAC)
Pennsylvania

Matthew Mehalik, Executive Director
Breathe Project
Pennsylvania

Dani Wilson, Executive Director
Cancer and Environment Network of Southwestern Pennsylvania
Pennsylvania

Joseph Minott, Esq., Executive Director and Chief Counsel
Clean Air Council
Pennsylvania

Sandy Field, Chair
Climate Reality Project: Susquehanna Valley PA Chapter
Pennsylvania

Pouné Saberi, MD, MPH
Concerned Health Professionals of Pennsylvania
Pennsylvania

Alison L. Steele, Executive Director
Environmental Health Project
Pennsylvania

Shannon Smith, Executive Director
FracTracker Alliance
Pennsylvania

Terrence Collins, Teresa Heinz Professor of Green Chemistry and Director
Institute for Green Science, Carnegie Mellon University
Pennsylvania

Ashley Funk, Executive Director
Mountain Watershed Association
Pennsylvania

Tamela Trussell
Move Past Plastic (MPP)
Pennsylvania

Patrick McDonnell, President & CEO
PennFuture
Pennsylvania

Dianne Peterson, PASUP Steering Committee Member
Pittsburghers Against Single Use Plastic (PASUP)
Pennsylvania

Gillian Graber, Executive Director
Protect PT (Penn-Trafford)
Pennsylvania
Alan Peterson, MD
Pennsylvania

Glenn Olcerst, Co-Founder & General Counsel
Rail Pollution Protection Pittsburgh (RP3)
Pennsylvania

[redacted]
Pennsylvania

Sr. Kari Pohl, Congregational Coordinator of
Justice and Peace
Sisters of St. Joseph of Baden, PA
Pennsylvania

Heather Hulton VanTassel, Executive Director
Three Rivers Waterkeeper
Pennsylvania

Tom Duffy, Health and Safety Specialist
United Steelworkers
Pennsylvania

Michelle Naccarati-Chapkis, Executive Director
Women for a Healthy Environment
Pennsylvania

Crystal Cavalier, Co-Founder/CEO
7 Directions of Service
North Carolina

Jennifer M. Hadayia, MPA, Executive Director
Air Alliance Houston
Texas

Pamela Miller, Executive Director
Alaska Community Action on Toxics
Alaska

Mily Trevino-Sauceda, Executive Director
Alianza Nacional de Campesinas, Inc.
California

Katie Huffling, Executive Director
Alliance of Nurses for Healthy Environments
Maryland

Mashal Awais, Community Science Manager
Bayou City Waterkeeper
Texas

Jane Winn, Executive Director
Berkshire Environmental Action Team (BEAT)
Massachusetts

Judith Enck, President
Beyond Plastics
Vermont

Nancy Tudor, Organizer-Volunteer
Beyond Plastics Schenectady
New York

Dr. Astrid Williams, Environmental Justice
Program Manager
Black Women for Wellness
California

Lisette van Vliet Senior, Policy Manager
Breast Cancer Prevention Partners (BCPP)
California

Chloe Brown, Policy Associate
Californians Against Waste
California

[redacted]
Washington

Pat Gonzales, Founder/Director
Caring for Pasadena Communities
Texas

Juan B. Mancias Tribal Chairman, Executive Director
Carrizo Comecrudo Tribe of Texas
Texas

Dr. Arthur Bowman III, Policy Director
Center for Environmental Health
California

Carroll Muffett, President
Center for International Environmental Law
District of Columbia

Carol Van Strum, Founder
Citizens Against Toxic Sprays
Oregon

Tracy Frisch, Chair
Clean Air Action Network of Glens Falls
New York

Barbara Heinzen, Member of Steering Group
Clean Air Coalition of Greater Ravena-Coeymans
New York

Emily Donovan, Co-Founder
Clean Cape Fear
North Carolina

Mark Rossi, Executive Director
Clean Production Action
Massachusetts

Lynn Thorp, National Campaigns Director
Clean Water Action
District of Columbia

Kristin Schafer, Director
Collaborative for Health and Environment (CHE)
California

Jill Berman, Ed. D., Co-Founder
Columbia County Reduces Waste
New York

Mady Hornig, Associate Professor
Columbia University
New York

Sharon E. Lewis, Executive Director
Connecticut Coalition for Economic and Environmental Justice
Connecticut

Maya Rommwatt, Sr. Market Campaigner
Defend Our Health
Maine

Daniel Savery, Senior Legislative Representative
Earthjustice
District of Columbia

Mark Dunlea, Co-Chair
EcoAction Committee of the Green Party of the U.S.
New York

Rebecca Meuninck, Deputy Director
Ecology Center
Michigan
ML Ballweg, President/Executive Director
Endometriosis Association
Wisconsin

John Peck, Executive Director
Family Farm Defenders
Wisconsin

Yvette Arellano, Director
Fenceline Watch
Texas

Jill Ryan, Executive Director
Freshwater Future
Michigan

Paloma Henriques, Senior Petrochemical Campaigner
Friends of the Earth
District of Columbia

Patti Wood, Executive DIrector
Grassroots Environmental Education
New York

H. William Copeland, MD, Director
Greater Northfield Watershed Association
Massachusetts

Emma Kriss, Food Campaigns Manager
Green America
District of Columbia

Ebony Twilley Martin, Executive Director
Greenpeace USA
Washington

Jaydee Hanson, Policy Director
International Center For Technology Assessment
District of Columbia

[redacted]
California

Kirstie Pecci, Executive Director
Just Zero
Massachusetts

Madeleine Foote, Deputy Legislative Director
League of Conservation Voters
District of Columbia

Dave Arndt, Director
Locust Point Community Garden
Maryland

Sydney Cook, Director of Science & Research
MADE SAFE
New York

Jim Vallette, President
Material Research
Maine

Laurene Allen, Co-Founder
Merrimack Citizens for Clean Water
New Hampshire

Zen Honeycutt, Founder
Moms Across America
North Carolina

Patrice Tomcik, Senior National Field Manager
Moms Clean Air Force
District of Columbia

Cynthia Palmer, Senior Analyst, Plastics and Petrochemicals
Moms Clean Air Force
District of Columbia

Kathleen A. Curtis, Founding Director
Moms for a Nontoxic New York
New York

Jane Thomason, Lead Industrial Hygienist
National Nurses United
California

Angel DeFazio, BSAT, BCNHP, President
National Toxic Encephalopathy Foundation
Nevada

Rosemary Wessel, Program Director
No Fracked Gas in Mass
Massachusetts

Julie Davenson
NOFA NH
New Hampshire

Niaz Dorry, Coordinating Director
North American Marine Alliance
Massachusetts

Lisa Adamson, Partner
North Country Earth Action
New York

Steve Gilman, Interstate NOFA Policy Coordinator
Northeast Organic Farming Association-Interstate Council
New York

Frank Rocchio, Founder
Ohio Valley Environmental Advocates (OVEA)
West Virginia

Jamie Pang, Environmental Health Program Director
Oregon Environmental Council
Oregon

[redacted]
Maryland

Dianna Cohen, CEO & Co-Founder
Plastic Pollution Coalition
California

Ron Kaminkow, Organizer
Railroad Workers United
Illinois

[redacted]
Maryland

Tony Tweedale
RISK Consultancy
Michigan

Sheyda Esnaashari, Drinking Water Program Director
River Network
District of Columbia

Roger Cook, Board Co-Chair
Riverside-Salem United Church of Christ
New York

Sarah Doll, National Director
Safer States
Oregon

Diane Wilson, Executive Director
San Antonio Bay Estuarine Waterkeeper
Texas

Ted Schettler MD, MPH, Science Director
Science and Environmental Health Network
California

Deborah Moore, Executive Director
Second Look
Vermont

Yvonne Taylor, Vice President
Seneca Lake Guardian
New York

Leslie Fields, Director - Policy, Advocacy and Legal
Sierra Club
District of Columbia

[redacted]
North Carolina

Dana Colihan, Co-Executive Director
Slingshot
Maine

Juan & Ana Parras, Co-Founder
TEJAS
Texas

Jan Dell, Independent Engineer
The Last Beach Cleanup
California

Jackie Nuñez, Founder
The Last Plastic Straw
California

Sam Pearse, Lead Campaigner
The Story of Stuff Project
California

Crystal Cavalier, Policy Director
Toxic Free NC
North Carolina

Mike Schade, Director, Mind the Store
Toxic-Free Future
New York

Bindu Panikkar, Associate Professor
University of Vermont
Vermont

Monica Unseld, Ph. D, MPH, Founder and Executive Director
Until Justice Data Partners
Kentucky

Jon Groveman, Policy Director
Vermont Natural Resources Council
Vermont

Peggy Shepard, Co-Founder & Executive Director
WE Act for Environmental Justice
New York

Juliann Salinas, Executive Director
Women, Food and Agriculture Network
Iowa

Jamie McConnell, Deputy Director
Women's Voices for the Earth
Montana

[redacted]
Massachusetts

[redacted]
New Jersey

[redacted]
Canada

[redacted]
Rhode Island

CC: Brenda Mallory, Chair, White House Council on Environmental Quality
Matthew Tejada, Director, EPA Office of Environmental Justice
Barry Breen, Acting Assistant Administrator, EPA Office of Land and Emergency Management
Anne Heard, Acting Deputy Assistant Administrator, EPA Office of Land and Emergency Management
Larry Douchand, Director, Office of Superfund Remediation and Technology Innovation
Doug Ballotti, Director, EPA Region 5 Superfund and Emergency Management Division
Paul Leonard, Director, EPA Region 3 Superfund & Emergency Response Division
Grant Cope, Senior Counselor to the Administrator, EPA

EXHIBIT 4

PEOPLE'S ACTION INSTITUTE
Center for Health, Environment & Justice
P.O. Box 6806 • Falls Church, VA 22040 • Phone: 703.237.2249 • Fax: 703.237.8389 • www.chej.org

March 20, 2023

Jami Derry
Amanda Kiger
River Valley Organizing
East Palestine, OH

Dear Jami and Amanda:

I have reviewed the Phase I – Preliminary Residential/Commercial/Agricultural Soil Sampling Plan East Palestine Train Derailment Site East Palestine, Ohio prepared by Arcadia US, Inc for Norfolk Southern Railway Company, March 6, 2023 (referred to herein as the Arcadia Report). This report is the proposed sampling plan for dioxins and other contaminants in soil that the US Environmental Protection Agency (US EPA) has required Norfolk Southern to carry out. This report addresses many, but not all of the issues I had raised immediately after EPA announced that they were requiring Norfolk Southern to conduct dioxin testing at the site.

Overall, I am concerned that the focus of this proposed sampling plan is not intended to identify the public health risks posed by the contamination throughout the community caused by the intentional burning of vinyl chloride and other toxic chemicals. Consequently, this proposed sampling plan is not likely to provide the confidence that the public is seeking that this testing will address its concerns and questions about the public health risks they face.

My main concerns about the proposed sampling plan are described below. I have also provided several recommendations to address these concerns.

1) **The proposed sampling plan is not intended to identify the public health risks posed by the contamination throughout the community caused by the intentional burning of vinyl chloride and other toxic chemicals.** The Arcadia Report defines the purpose of the proposed sampling plan in general terms as "a guide to soil inspection" (Arcadia Report, p. 2). My problem with this statement is that this testing is not intended to identify the public health risks posed by the contamination throughout the community. This distinction is important because the purpose of the plan determines the sampling that will be done and where the samples will be taken from. A more public health approach would include testing in areas where people live and where people directly experienced

the smoke cloud from the fire. Testing should also include farm animals such as chickens and farm products such as eggs and milk. There is no mention in the sampling plan report about addressing the public health risks posed by the contamination caused by the burning of vinyl chloride and other toxic chemicals.

This plan is identified as Phase I that "will be expanded in a Phase II version as results are received and the conceptual understanding of the distribution of shallow soil impacts develops" (Arcadia Report, p. 2). However, any additional testing that might be done in Phase II will be limited by the testing results from Phase I which are limited by the purpose and intent of this sampling plan.

2) **The proposed soil "inspection" approach to identifying where to collect samples is highly unusual and very subjective.** The oddest part of this sampling plan is the intention to walk the area and "inspect" the surface soil as a way of identifying the areas where they will collect samples. This approach is highly unusual because it is very subjective. The people walking the area will decide whether they "see" something that indicates to them that ash or other debris from the fire is present on the surface soil and use this observation as the primary basis for deciding where to take samples. Arcadia describes this process this way: "Visual inspections will guide sample collection, with samples collected from both visible ash material and shallow soil if ash material is present" (Arcadia Report, p. 2). Additional details are provided later:

> "Inspections will begin within the public right-of-way (ROW) and look for evidence of ash from the burn. Inspections will bias towards low lying areas where surficial runoff would likely place sediments. At a minimum, 75% of each inspection area will be walked, and documented for the presence/absence of ash or soot-like material. Walk paths will be included in the Inspection Reports (Arcadia Report, p.3).

This approach makes no common sense and it is not an approach that addresses the public health concerns that people are raising about the contamination. It assumes that evidence of contamination will be visually present. We are now approximately 6 weeks from when the fire occurred and the surface soil that existed immediately following the fire has likely been dramatically altered since that time. Rain, and possible snow (and the subsequent snow melt) would have pushed any evidence of contamination deeper into the soil. In addition, cold, the sun and wind would have contributed to altering the "look" of the surface soil. Sadly, this approach reminds me of some of my children's reading books that use a scratch and sniff approach to getting the kids attention.

A more traditional approach would be to collect surface soil samples in a concentric circle over increasing distance from the source of the fire, collecting more samples in predominately downwind areas. Visual inspection could be a part of the process used to select soil sample locations, but it should not be the primary driver.

This inspection process is also limited to a target sampling area that is defined in the Unilateral Administrative Order (UAO) between the US EPA and Norfolk Southern. It's not clear what this area is. There is a description of the general area where sampling will be done (see Arcadia Report, p. 3), but it is not clear how this area relates to the restrictions imposed by the administrative order. This document should be made available to the public.

There is mention that additional soil samples will be collected from "... inspected locations where no ash material is identified via the visual inspection..." and based on "... land-use type inventoried as inspections begin..." (Arcadia Report, p. 2) but it is unclear just what this means and how many samples this may include. No details are provided on how these sample locations will be selected, or how many will be included.

Arcadia also mentions that this sampling should be considered as Phase I of the testing and that there may be a Phase II, though that will depend on the results of what they find in Phase I (Arcadia Report, p. 2). If they do not find the presence of contamination in Phase I, they will not likely do any additional sampling. This is troubling because they are selecting where to test primarily based on visual inspection of the surface soil. If in their opinion, they do not "see" evidence of contamination, they will not collect samples. If they do not collected samples, they will not find evidence of contamination.

3) **The detection limits that will be used to analyze the collected samples are not disclosed.** Another major concern I have with the proposed sampling plan is that the detection limits that will be used to analyze the samples are not included in the report. This is very important because of the toxicity of dioxins at extremely low concentrations. It is very important to analyze the samples for dioxins at concentration- in soil in the low parts per trillion (ppt) level. Dioxins can cause their toxic effects at this concentration level and if the analysis is not designed to detect concentrations at this level and even lower, it will not be detected, even if it is there. Put another way, if the detection limits are too high, the results will indicate that no dioxins were detected and the conclusion made will be that there are no dioxins in the soil, even though it may be present at concentrations below the detection limit. Perhaps more importantly, we will not know if dioxins are present in the soil because the detection limits are too high.

Detection Limits are defined as the lowest concentration of a substance that can be identified in a sample. This level is set by the analytical laboratory based either on the predetermined goals of the analysis, the resolution capacity of the lab's instruments or a cost restriction imposed by the client. The lower the detection limit, the higher the cost.

In summary, for these reasons, I am concerned that the proposed testing will not provide the information that is needed to evaluate whether dioxins are present in the surface soil following the intentional burning of vinyl chloride and other toxic chemicals by Norfolk Southern. I am very concerned that the goal and purpose of the sampling plan is not intended to identify the public health risks posed by the contamination throughout the community. I am troubled by the plan proposed by Norfolk Southern's contractor to select where it will collect soil samples primarily by walking and visually "inspecting" the surface soil "looking" for the presence of contamination. This approach is highly subjective and will not provide the confidence that the public is seeking that the testing is addressing its concerns and questions about proper testing for dioxins. Lastly, I am concerned that the propose sampling plan does not include the detection limits that will be used to analyze the samples that will be collected.

To address these concerns, I offer the following recommendations:

1. I would request that Norfolk Southern drop the visual inspection approach as its primary means to identifying where to collect samples. A more objective approach would be to collect surface soil samples in a concentric circle over increasing distance from the source of the fire, collecting more samples in the predominately downwind areas. If they refuse to do this, **then ask to have a scientist of your choosing participate in the inspection process.** It's fine to include visual inspections as one means for selecting sample locations, but it should not be used as the prime basis for making this decision.

2. Consider requesting that the USEPA provide the community with a Technical Assistance Grant (TAG) so that you can hire a scientific advisor of your choosing to help the residents with the many scientific and technical issues that you are facing.

3. Request that Arcadia disclose the detection limits will be used in the analysis of the soil samples that will be analyzed as part of this sampling effort. Ideally, the detection limits for dioxins should be no greater than 0.001 micrograms per kilogram (ug/Kg) which is equivalent to parts per trillion (ppt).

4. In addition to collecting samples from soil, water and sediment samples should be taken from creeks and streams in the area. Samples should also be taken from farm animals such as chickens and from farm products such as eggs and milk and analyzed for dioxins.

5. Consider requesting that EPA take a number of split samples (5 or 6) to help provide a level of accountability for the sampling that will be done by a contractor working for Norfolk Southern. Split samples are samples that are collected from one location that are split into two distinct samples that are sent to two different laboratories for analysis. Each lab analyzes its sample for the exact same substances using the exact same analytical procedures. The results are then compared to see how similar they are. They should be very close. This is common practice by EPA when having work done by contractors for responsible parties. EPA would select the second lab to send the split sample to. The community could offer a recommendation for a lab to do the second analysis as well.

6. The final analytical report for dioxins should include a Total Equivalent Quotient (TEQ) value for the dioxins found in each sample. The TEQ value sums the toxicity of the various dioxin and furan congeners using weighted toxicity factors. Public health risks are best evaluated using a TEQ value for the sum of all dioxins present in a sample. Request that a TEQ value be included with each dioxin analysis for each sample.

7. The Unilateral Administrative Order (UAO) between the US Environmental Protection Agency (EPA) and Norfolk Southern should be made public. This will provide clarity on the area defined in the UAO as the impacted area that limits the inspection area where samples will be collected as part of this Sampling Plan. Request a copy of this document from the USEPA.

8. The Derailment-area Soil Characterization Work Plan is discussed in the Arcadia Report. This document characterizes the soil in close proximity to the derailment site that would have been directly impacted by toxic chemicals released by the accident. This area is **NOT** included in the area targeted for testing in this sampling plan. This information is important to understand and should be made public. Request a copy of this document from the USEPA.

Please feel free to contact me if you have any questions, or if you want to discuss these comments.

Sincerely,

Stephen Lester
Science Dir
ector

EXHIBIT 5

Unity Council for the EP Train Derailment
Community Oversight Subcommittee
East Palestine, OH 44413
(p) 330.314.4422 (e) unitycouncil2023@gmail.com

Honorable Governor Micahel DeWine
Riffe Center, 30th Floor, 77 South High St.
Columbus, Oh 43215-6117

April 22, 2023

Dear Governor DeWine,

We, The Unity Council for the EP Train Derailment, are humbly requesting you to issue a disaster declaration in regards to the Norfolk Southern train derailment which happened February 03, 2023. The aforementioned council represents not only your constituents in East Palestine but your constituents in outlying areas that were impacted by the chemical bomb ignited over our village and miles beyond.

Our situation has been assessed. The EPA claims they can not find an exposure pathway between the carcinogens from the derailed tankers and public health issues. However, the EPA acknowledges **PEOPLE** are sick,the local government acknowledges **PEOPLE** are sick and the **PEOPLE** are screaming they are sick. No matter who agrees or disagrees on test findings, we can all agree on the public health issues being present. Furthermore, it is **FACT** that **PEOPLE** are sick as many have tested positive for vinyl chloride in their urine. **PEOPLE** would not still be testing positive if they were not actively being exposed to the chemicals.

It is obvious that the situation created by Norfolk Southern is beyond the capabilities of our local and state governments. Our local and state governments are capable of alot but a disaster of this magnitude needs the attention of all levels of government. This can be evidenced by the fact that PEOPLE are still suffering, in unsafe homes and the derailment happened well over two months ago.

For all of the reasons stated above, and more, our communities have united to beg of you to show our families mercy by declaring a state of emergency. We need federal assistance and we need it now. This is not politics, these are **PEOPLE'S** lives!

Sincerely,

Unity Council for the EP Train Derailment

EXHIBIT 6

Senator Sherrod Brown, J.D. Vance
Congressman Bill Johnson
(sent by email)
Hart Senate Office Building, 201 2nd St NE, Washington, D.C. 20002

June 17, 2023

Dear Senators and Congressman representing Ohio:

I am a professor at Purdue University evaluating health risks of conditions that impact people and businesses in and around East Palestine, Ohio. I want to share important findings with you. After my June 10-12 investigation in East Palestine, I have serious concerns for the safety of children, adults, and businesses. During this, my sixth field investigation, I discovered, again, that *acute chemical exposures* are occurring inside some residential and commercial buildings near the derailment site and along the contaminated Sulfur Run. **I provide four recommendations below.**

There are still acute health threats inside buildings that agencies have yet to eliminate. Several buildings around the derailment site and along Sulfur Run still have the characteristic odor of chemical contamination. I have smelled it firsthand and we have been doing nearby environmental testing. Last week some occupants indicated that they became ill and have been avoiding certain buildings even after airing them out repeatedly. Some occupants have paid for indoor air testing which revealed butyl acrylate exceeding the ATSDR screening level, soot was present, and other chemicals present (e.g., ethylhexyl acrylate, benzene). Other occupants do not have financial ability to pay for indoor air testing, but I can confirm the odor was present. Norfolk Southern contractors did visit some buildings in February using inadequate air testing devices[1], and in one case, their team left the building because of the unpleasant odor they encountered. Some occupants told me that Norfolk Southern said they will not help them because there is legal action against them. Some building occupants have told me they cannot spend more than 2 to 5 minutes inside their building without experiencing side effects. In February/March, the East Palestine Municipal Building (85 N. Market Street), where town council meets, was contaminated with chemicals from Sulfur Run. Agencies found chemicals entering through unplugged drain pipes beneath the building. This was corrected, but contamination in other residential and commercial buildings remains.

Actions needed are to:

1. Decontaminate all residential, commercial, and government buildings surrounding the derailment site and along Sulfur Run. This will help maintain anonymity.
2. Conduct chemical testing inside these buildings for soot and over several weeks for volatile organic compounds (VOC) and semi-volatile organic compounds (SVOC).
3. Inspect and eliminate pathways where chemicals enter buildings from the Sulfur Run culverts that go underneath and alongside buildings (i.e., building pipes, drains, cracked concrete, sumps, etc.).

Evidence shows that this disaster has repeatedly exceeded the scientific and organizational capability of the USEPA and other agencies involved. You may consider recommending:

- The assembly and charging of an independent team of public experts to advise decision makers about scientific issues with this disaster. Areas of expertise needed are air quality, water quality, materials, civil engineering, environmental engineering, mechanical engineering, public health, environmental health, epidemiology, groundwater, risk assessment, among others.

Please do not hesitate to contact me. I can be reached at awhelton@purdue.edu.

Sincerely,

Andrew Whelton

[1] Borst and Bogardus. *E&E News*. June 1, 2023. https://www.eenews.net/articles/epa-promised-clarity-transparency-after-ohio-train-derailment-but-some-air-monitors-didnt-work/

EXHIBIT 7

An interview with a resident of East Palestine -- June 23, 2023 - some shocking revelations.

Alderman, Nancy [redacted]
Fri 6/23/2023 6:50 AM
To: Scott Smith [redacted]

An interview with a resident of East Palestine -- June 23, 2023 - some shocking revelations.

We must go back to the night of the train wreck of Norfolk Southern's train carrying carloads of the chemicals that make-up Vinyl Chloride -- it was the evening of February 3rd - 4 ½ months ago.

1. **What we know now that no one knew then.** The train only had one car that had broken apart and was spilling Vinyl Chloride. The Norfolk Southern (NS) Railroad decided to blow up 4 more cars that had derailed but were not stressed --- so to clear the tracks. Now there were 5 cars spilling vinyl chloride all over the land, creeks and waterways of East Palestine. The railroad then decided to set fire to all the chemicals and burn them sending billowing black toxic smoke for miles around. That was February 3rd and days following.

2. **An EPA official has admitted that their testing devises were not capable of testing for all the chemicals-of-concern. Some of the chemicals that EPA did not not test for are dangerous to human Health.** The EPA has been concerned it would get sued and has therefore acted in a defensive manner - rather than what was the best interest of the resident's health. This information

[redacted] 1/4

about what the EPA was not testing for was actually divulged in April - but at the time it was not picked up by the media - so it sat with no one paying attention to this important information.

3. **After this, the residents of the town were/are in desperate need of help. What help do they get?** The CDC comes in and tries to calm the people down. The CDC people get sick and they are pulled out. EPA tests the Air and monitors it. No one tests the soil or the water. Finally, the Norfolk Southern Railroad agrees to test the land and the water but never releases its findings. Even if they did - they would never be trustworthy as they are the offenders.

4. **Money starts to come in but where does it go?** Contributed donations go to the town, businesses, and schools - none go to the actual residents who need bottled water, air filters - water filters, and many other needs.

5. **Who gets evacuated, who decides, and how long will NS railroad pay?** Residents living one mile from ground zero get preference - but because the railroad claims the houses are now safe to go back into -- who knows how long the funding will last. Some people are in hotels, some are in Airbnb's, and some wherever they could find.

6. **Residents are pretty much left on their own to save themselves.** As many good hearted residents were trying to go house to house to help people - the Mayor and the Police Department stopped them saying they would need a $400 canvassing permit to go house to house - so they had to stop helping people.

7. **The Railroad is now working overtime to co-op the Town, the Town Council and the Schools-- how did they do this - with money.** The public relations section of that corporation has been working full time buying the town, schools and people off. We will name a few things, of the many, they are doing: Fireworks on the Fourth of July; a 25 million dollar new Park; Street Fairs; buying things for students like sports equipment; coloring books for young children that EPA puts out.

8. **What is the NS Railroad doing for local Businesses?** NS Railroad and the EPA are renting space from local businesses. The Railroad has offered to take goods from vendors to their Georgia Headquarters where they will do what with the contaminated products - who knows?. Free haircuts for children and the community; free pet grooming.

[redacted] [redacted]

9. **What about the residents who are continually exposed to toxic chemicals?** The residents are pretty much left to fend for themselves. That means they must figure out their own exposures, what to do about them, if they are sick how to get help. The railroad is not paying for residents' additional health care issues due to the toxic spill exposures. If their houses can never be lived in again --- who will make the railroad pay for those houses and at what rate will they pay?

10. **Meanwhile the town is now divided on how to proceed. That is thanks to the NS Railroad pouring money into certain parts of the town.** By spending so much money on the schools, the town and businesses, some people do not want to come down on the railroad fearing the money would stop coming to their pet projects. The NS Railroad has been strategic of where to give their money. It seems as if many people in the town have been bought off by the NS Railroads money. Meanwhile the town residents are sick and need all the help they can get. Government must step in.

[redacted] 3/4

[redacted] [redacted]

EXHIBIT 8

Tuesday, August 22, 2023 at 14:50:34 Eastern Daylight Time

Subject: Re: Clearing Up Confusion - My "Agenda"
Date: Thursday, July 27, 2023 at 6:25:04 AM Eastern Daylight Time
From: Scott Smith
To: Durno, Mark, [redacted] Burgess, William K.
CC: [redacted]
Attachments: image001.png, ATSDR-TEQ-Guidance-Dioxin-and-Dioxin-like-Compounds-508...4-15-2022.pdf

All,

Please understand that this is a response to this entire e-mail chain.

I remain willing to have an open dialogue and collaboration with Norfolk Southern and/or the EPA and/or any Norfolk Southern Contractors and/or anyone involved in the Unified Command Center, but it will be on equal terms with information shared in both directions.

The following is my response:

- I came into the community of East Palestine in February of 2023 at the request of residents of East Palestine to help the community. My mission is to provide supportive information to the impacted community. Subsequent to my initial testing and visits to East Palestine, an expert team was formed around me with individuals with over 150 years of experience including but not limited to medical and dioxin/other chemical investigations/cleanups. The means and metrics we use do not necessarily need to comport with the US EPA protocol dogma. With that being said, I understand that the EPA is on record saying that the EPA does not dispute my testing results.

- Our data is our data and it provides a factual account of results. Other than providing selected summed concentration data, the lab-reported TEQ values have supplemented concentrations. Limitations of TEQ as a technique are addressed below. We can defend the discipline of our methods of sampling, and we can explain what I have done in my field sampling, but we do not need to provide our rationale for doing so.

- The lab I have used is a certified US EPA lab that follows US EPA applicable protocols and procedures in the testing process, specifically Method 8290 for dioxins. As previously stated, I understand the EPA is on record accepting the test results from the lab I have used.

- We are not under any obligation to the US EPA, Ohio EPA, or Norfolk Southern to share private data from private properties.

- The US EPA does not have explicit authority via condemnation or similar tactic to take samples of any kind unless the private entity is a suspected polluter.

- The East Palestine Norfolk Southern train derailment appears to be uncharted waters. Due to the complexity of the incident and subsequent decisions, this may be a rare incident wherein multiple congeners of dioxins (and furans) were generated by the post-derailment fire and "controlled" burn. These source incidences produced extended air-borne PIC-laden (product of incomplete combustion) plumes depositing over a broad area. This atmospheric deposition was augmented by on-going accretive, dioxin-laden dust resuspension and settling. This contribution derives not only from current remedial measures but also from ambient dioxin dust mass wasting from the initial open burn and the subsequent open "controlled" burn. Given the time history and the multiple continuing contaminant

loading, there is a need to go back over previously sampled locations to verify current dioxin levels.

- The US EPA TEQ protocols can yield an incomplete measure of human impacted dioxin burden. According to the most recent publications from ATSDR/CDC guidance (attached to this e-mail), it states in section 2.1 as follows: ***"Overall, the TEQ framework provides a scientifically justified, health protective, and widely accepted method for evaluating toxicity of mixtures of dioxin and dioxin-like compounds (NAS, 2006). However, the method has inherent uncertainties and may not capture the true health risks of all congener exposure scenarios."***

- Furthermore, this publication (attached to this e-mail) goes on to say that assessors should reference particular comparison values (CV's) not only for those congeners included in the TEQ due to their mode of toxicity being similar to 2,3,7,8-TCDD but also for selected other congeners that have individual CV's. Section 1.1 states: ***"Health assessors should also be mindful that several individually measured chemicals accounted for in the TEQ have their own CV's and/or health guidelines and should therefore be evaluated separately - meaning, these chemicals should both (1) be evaluated individually and (2) factored into the TEQ calculations."***

- The foregoing considerations do not address the basic toxicological fact that congeners not having TEQ factors or individual comparison values are not inherently safe toward environmental or human health. See below discussion for further elaboration.

- Per Dr. Golomb all chemical values of pollution are of concern. A medical doctor and/or a toxicologist starts with all chemical and toxicological values available. These chemical values collectively are additive towards total body burden and will guide subsequent diagnosis and treatment regimens. Citing a singular exposure to a single chemical and declaring the community "safe" is confusing and can be misleading. The following text from an e-mail I received from Dr. Golomb provides more clarity on this issue:

Furthermore, here is what Dr. Golomb stated to me verbatim when I asked her about declaring levels of contaminants "safe" in a broad-based way for an entire community:

"Dear Scott,

You asked whether if the government states that level of toxins are safe, EP residents can be secure that there is no problem.

Particularly, if some people continue to have symptoms, there remain concerns.

The following considerations pertain:

0. ***It is unlikely that levels have been tested for every relevant chemical, and in every location where heightened levels may have been retained.***

0. ***The effects of chemical combinations of this type are unknown. There is not a systematic process for testing the safety of chemical combinations. For any "N" (number of) chemicals, the N combinations is 2 to the power N (that is, 2 multiplied by itself, with a total of 2x2x2... where there is the "N" of 2s being multiplied. Where there are 5 chemicals, there are 32 possible combinations; by the time there are 10, there are over 1,000 possible combinations.***

0. ***In Europe, the "precautionary principle" is followed, by which there should be evidence***

that a chemical is safe before it is approved. The US does not adopt any such precautions.

0. ***Even for things that have undergone safety testing, it is often only with widespread exposure that harms -- sometimes even common and important ones -- are identified. For instance, for medications, which are also chemicals, and which must undergo human testing for marketing ~1 in 5 will be withdrawn or have a major black box warning after full testing and approval for release. The median time to these regulatory actions is 7 years after full approval. There is a log tail so that harms of some things are not identified until considerably later, and this can occur even for significant problems.***

0. ***We know regarding chemical combinations settings like the Persian Gulf War that involved chemical mixtures culminated in chronic health problems in a good fraction of those deployed (~1/3), health problems that were not anticipated based on knowledge of the individual chemicals at the time. As is common after environmental exposure episodes, the possibility of health problems due to these exposures was initially widely dismissed.***

0. ***Although other kinds of health problems can also arise, there is evidence from several settings that persons that have "acute" adverse effects to an exposure are more likely to have chronic effects apparently attributable to that exposure. The acute adverse effect may both be a marker of prior vulnerability, and a marker that mechanisms are engaged that could contribute to later problems.***

0. ***Effects are not distributed equally across the population. Levels that are apparently "safe" for many may still be a significant problem for a subset, and time may be required to learn what that subset is. An illustration I often use is an analysis of insurance claims data by the FDA, which looked at the rates of a serious muscle breakdown condition in people who took "statin" cholesterol lowering drugs. The overall rate was ~1 in 23,000 per year of use for people on statins alone. However, the rate was ~50-fold higher in older diabetics also taking a medication class called fibrates, and it was ~50-fold higher again in the most unfavorable statin (with regard to interacting with fibrates). So, in an important subgroup that would commonly be given statins, the rate of this seriously and potentially fatal adverse effect was 1 in 10 per year of use. So, this is the difference between the problem looking very rare and very common in a key subgroup..."*** – Dr. Beatrice Golomb

- I have nothing but respect for Mark Durno and over 95% of the great US EPA people I have met in my work over the last 17 years; however, with all due respect when it comes to the current US EPA data for East Palestine, we feel that the definition and applicability of TEQ protocol dioxin data is not understood by the public writ large. Further it only provides an incomplete picture/measure for public understanding and consumption, asking the public to do the conversions from ppm to the units of the TEQ measure alone is a daunting task for the impacted citizenry, hence, why we present our data the way we do.

- Referring to the preceding bullets above, our data was never implied to be a measurement of risk. Our data is an empirical measurement of values found. Furthermore, most of the congeners of dioxins that were reported by our USEPA certified laboratory do not have an assigned TEQ VALUE because they simply do not exist.

- It is of paramount importance to understand the totality of <u>all</u> chemical compounds are discreetly and collectively important to a toxicologist. When determining total chemical burdens with humans, clean

up remediation concentrations simply are not relevant to the medical clinicians.

- We understand there is a "Unified Command Center", but with all due respect it appears to be a Unified Information Center. This Unified Information Center then appears to follow a specific narrative and if someone like me or my team does not follow the narrative or questions the narrative; then, Undue Influence comes into play with public relations firms and lobbyists to undermine and defame people like me and those on my team. We are fully prepared to deal with this but would prefer not to have to deal with this and remain focused on our mission to provide supportive information to the community.

- Norfolk Southern may want to consider a different tactic than the typical PR playbook (Delay, Deny, Discredit, Dismiss, Defame) and try working directly with me and my team for the benefit of the community. Note I added a fifth D as in Defamation to the 4 D's of PR based on the latest statements and communications from Norfolk Southern.

Best Regards,

Scott Smith

From: Mark Durno [redacted]
Date: Tuesday, July 25, 2023 at 11:23 AM
To: [redacted], William Burgess [redacted]
Cc: Scott Smith [redacted], [redacted]
Subject: RE: Clearing Up Confusion - My "Agenda"

Good morning [redacted]

As a member of the Incident Command & Unified Command team, I'm happy to meet with you all next week. EPA will collaborate with any organization that provided information that is relevant to our work on this response. If you'd like to meet before that, I'm happy to stop by.

My message to our Unified Command partners last week was that the manner in which the information was provided to the public last week was confusing and we are highly concerned about how it communicated. We also shared that EPA needs significantly more information regarding Scott's sampling approach and methods. We look forward to discussing these issues with Scott's advisors.

Call anytime – my mobile number is 440-476-7988.

Mark

Mark Durno
Homeland Security Advisor
U.S. EPA Region 5
25063 Center Ridge Road
Westlake, OH 44145
440-476-7988 (c)

From: Mar Figley [redacted]
Sent: Tuesday, July 25, 2023 11:05 AM

To: Burgess, William K. [redacted]
Cc: Scott Smith [redacted]; Durno, Mark [redacted]; [redacted]
Subject: Re: Clearing Up Confusion - My "Agenda"

Good Morning Will,

I reviewed the emails between you and Scott Smith.

I would like to say that the points that Scott made regarding our conversation were correct with the exception that you (Norfolk Southern) did not say that you would not work with Scott; however, you did clearly say to me that the EPA will not work with Scott.

Can you please direct us to whom we should contact at the Unified Command Center? We are still hopeful that this issue can be worked out without seeking more formal remedies.

Scott will be back in East Palestine on Monday, July 31 and Tuesday, August 1. We (including Scott) are more than willing to sit down with a representative or representatives from the Unified Command Center and/or Arcadis and/or Norfolk Southern and/or the EPA to go through the detailed test reports from all sides and have a discussion. Data and testing sharing should be equal in both directions and not one-sided.

Additionally, as Scott has repeatedly offered to do side by side testing with Norfolk Southern (including its contractors) and/or the EPA and/or any representatives from the Unified Command Center, his offer remains open and we would welcome side by side testing next week.

Thank you and I hope we can continue to work with you and John Fletcher on the smaller issues with our home and business.

Respectfully,

[redacted]

On Mon, Jul 24, 2023 at 4:06 PM Burgess, William K. [redacted] wrote:

> Mr. Smith,
>
> I appreciate you reaching out in response to my conversation with [redacted]. As I advised [redacted], my role in this incident is primarily over the Family Assistance Center and claims. Your understanding of my

conversation with [redacted] is not entirely correct and clearly missing context, but given our respective roles in this incident I do not feel comfortable engaging further in this conversation with you. Given your role in this incident, I would advise you to direct any future correspondence to Unified Command.

Thank you,
Will

William Burgess
Regional Manager, Law Department/Legal Claims
Norfolk Southern Corporation | 1100 1st Avenue | Conway, PA 15027
Cell: 412-400-0934 | Fax: 470-463-5063 | Email: William.Burgess2@NSCorp.com

From: Scott Smith [redacted]
Sent: Monday, July 24, 2023 3:53 PM
To: Burgess, William K. [redacted]
Cc: Durno, Mark [redacted]
Subject: [EXTERNAL] Clearing Up Confusion - My "Agenda"
Importance: High

William (Regional Manager Norfolk Southern),

I understand you had a phone call with [redacted] today. This e-mail will serve to document the phone call in a good faith attempt to clear up confusion.

I understand you told [redacted] the following and this e-mail serves to memorialize your conversation with [redacted] this afternoon:

1. Scott Smith has a personal agenda, and we (Norfolk Southern) don't know what it is and we will not meet with him (meaning me).

2. Mark Durno informed the railroad that the meeting with me (Scott Smith) did not go well the other day.

3. Norfolk Southern hired Arcadis but Arcadis takes all direction and supervision from the EPA.

4. The EPA will not work with me (Scott Smith).

I will go on record right now in this e-mail that I don't believe for one second that Mark Durno nor anyone at the EPA said the things you claim he said in your conversation with [redacted] I have great respect for Mark and I feel that I had a productive meeting with Mark the other day with the goal of moving forward with Mark/the EPA in collaborating to help the community of East Palestine.

I will be very clear with you. My agenda is preservation and protection of the health of communities in contamination disasters like East Palestine along with preservation and protection of the environment. I refer to this as Sustainability without Compromise. Given the EPA's website and Norfolk Sothern's website as to sustainability and protecting human health and the environment, it appears to me that we all have the same "agenda."

I plan to test 885 Taggart Street again next week and Norfolk Southern and the EPA are invited to join me.

I am still very much open to a meeting with Norfolk Southern, Mark Durno/EPA, and the [redacted]s. Refusal of Norfolk Southern and/or the EPA to attend a good faith meeting strongly suggests to me that Norfolk Southern and/or the EPA may have an agenda that neither I nor the [redacted]s are aware of and understand at this point.

Please be advised I am well aware of how this all works with large corporations and public relations people, public information officers, lobbyists, etc (collectively what I call Undue Influence), and with all due respect this just gets in the way of resolution and helping solve the problems for the community of East Palestine.

I look forward to hearing from you and Mark Durno and clearing up this confusion.

Best Regards,

Scott Smith
Phone: (508) 345-6520

ATSDR Office of Community Health Hazard Assessment
Toxic Equivalents Guidance for Dioxin and Dioxin-like Compounds

Citation:
[ATSDR] Agency for Toxic Substances and Disease Registry. 2019. Toxic Equivalents Guidance for Dioxin and Dioxin-like Compounds. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Contents:

List of Tables

List of Abbreviations

ADS	Associate Director for Science
AhR	aryl hydrocarbon receptor
ATSDR	Agency for Toxic Substances and Disease Registry
CAS	Chemical Abstracts Service
CV	comparison value
DCHI	Division of Community Health Investigations
DLC	dioxin-like compound
EDG	Exposure Dose Guidance
EMPC	estimated maximum possible concentration
EPC	exposure point concentration
ISM	incremental sampling methodology
KM	Kaplan-Meier
MRL	Minimal Risk Level
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
PHA	public health assessment
RfD	reference dose
RPD	relative percent difference
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TEC	toxic equivalent concentration
TEF	toxic equivalent factor
TEQ	toxic equivalent
USEPA	U.S. Environmental Protection Agency
95UCL	95 percent upper confidence limit of the arithmetic mean
WHO	World Health Organization

Note

Since the time when this guidance was originally drafted, the Agency for Toxic Substances and Disease Registry (ATSDR) has developed an online tool that automates the calculations outlined in this document (i.e., ATSDR's EPC Tool). Health assessors are encouraged to use that tool when estimating EPCs for dioxin and dioxin like congeners. This guidance walks through steps to use a separate tool developed with an Excel macro. Health assessors may still choose to use this tool when they need to estimate a toxic equivalent (TEQ) value for a single sample.

This guidance mentions software applications by name (e.g., Microsoft Excel). Use of these trade names is for identification purposes only and does not constitute an endorsement of their use.

1.0 INTRODUCTION

When multiple chemicals in the same chemical class have sufficiently similar toxicological properties, toxic equivalents (TEQs) can be used to express the numerous chemicals' overall toxicity as a single value. This document presents the Agency for Toxic Substances and Disease Registry's (ATSDR's) guidance for calculating TEQs for dioxin and dioxin-like compounds (DLCs)—a class of related halogenated aromatic hydrocarbons that are specially handled in ATSDR public health evaluations.

This guidance presents ATSDR's preferred statistical procedures for calculating TEQs and specifically considers uncertainties associated with environmental sampling data that contain non-detect observations. Calculating TEQs with non-detect results is not a new concept, and many textbooks, articles, and other publications present different approaches for doing so. However, health assessors are expected to follow the computational approaches presented in this guidance, which address specific nuances of environmental data for dioxin and DLCs. Computational approaches other than those prescribed in this guidance should not be used, unless first approved by an Associate Director for Science (ADS) group.

Focus of This Guidance

This guidance walks health assessors through the process of calculating the TEQ for *a single sample* of dioxin and dioxin-like compounds.

Once TEQs have been calculated for all samples in an exposure unit following the procedures in this guidance, health assessors should then apply principles in other guidance documents (e.g., ATSDR, 2019a; 2020a) to determine what TEQ value to use as the exposure point concentration for the health evaluations.

This guidance supersedes ATSDR's 2012 guidance document on dioxins and DLCs (ATSDR, 2012). The current guidance incorporates more advanced statistical approaches to handling non-detect results and provides an Excel macro tool for easy computation.

1.1 When to Use This Guidance

During the public health assessment process, health assessors perform many activities, such as: developing a conceptual site model, evaluating exposure pathways, identifying exposure units, compiling and reviewing environmental data, and screening those data against health-based comparison values (CVs). ATSDR has developed other guidance to assist health assessors with these and many other steps in public health evaluations. Health assessors should follow the guidance in this document when working on sites with measured concentrations of dioxins and DLCs in any environmental media (e.g., soil, groundwater, surface water, fish tissue, outdoor air, and indoor air).

This guidance specifically outlines how to reduce data for an environmental sample analyzed for dioxin and DLCs into a single TEQ value, and should be applied prior to screening data against CVs and calculating exposure point concentrations (EPCs) for health evaluations. The guidance was not developed to address how to use and interpret the results for those evaluations. But briefly, health assessors should treat TEQs like concentrations of any other environmental contaminant. In this case, health assessors should evaluate TEQs using comparison values, health guidelines, and other resources specific to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). Health assessors should also be mindful that several individually measured chemicals accounted for in the TEQ have their own CVs and/or health guidelines and should therefore be evaluated separately—meaning, these chemicals should both (1) be evaluated individually and (2) factored into the TEQ calculations. These chemicals currently include:

- 2,3,7,8-Tetrachloro dibenzo-p-dioxin (CAS No.: 1746-01-6)
- 1,2,3,6,7,8-Hexachloro dibenzo-p-dioxin (CAS No.: 57653-85-7)
- 1,2,3,7,8,9-Hexachloro dibenzo-p-dioxin (CAS No.: 19408-74-3)
- 2,3,4,7,8-Pentachloro dibenzofuran (CAS No: 57117-31-4)

Once health assessors have calculated a TEQ for each environmental sample with the methods described in this document, they should screen both the calculated TEQs and the measured concentrations of the four chemicals listed above against ATSDR recommended CVs for **both cancer and non-cancer** (e.g., environmental media evaluation guides [EMEGs] and cancer risk evaluation guides [CREGs]). If any of the individual sample TEQs or chemical measurements exceed applicable CVs in a potential or completed exposure pathway, health assessors must perform a more detailed risk evaluation.

Using Calculated TEQs

Health assessors can use the TEQs calculated following the procedures outlined in this guidance to evaluate both cancer and non-cancer effects. Evaluate the calculated TEQs like any other contaminant in the public health assessment process, by first screening the TEQ against the recommended cancer and non-cancer CV. If the calculated TEQ meets or exceeds a CV, health assessors should determine the EPC for that exposure unit and then estimate non-cancer hazards and cancer risks.

For these evaluations, health assessors estimate EPCs using the calculated TEQs for all environmental samples collected within an exposure unit. To do so, they should follow applicable ATSDR Exposure Dose Guidance (EDG) on how to define an exposure unit (ATSDR, 2020b) and on how to calculate EPCs (e.g., ATSDR, 2019a; 2020a). Health assessors would use these EPCs to calculate doses and then compare those doses to appropriate health guidelines (e.g., minimal risk levels [MRLs], reference doses [RfDs], cancer slope factors [CSFs]), like any other contaminant in the public health assessment process. For dioxin and DLCs, this means applying health guidelines for 2,3,7,8-TCDD to calculated TEQs, as well as applying available health guidelines for the four chemicals specified above.

1.2 Topics Not Covered by This Guidance

This guidance specifically addresses approaches for evaluating environmental sampling data for dioxin and dioxin-like compounds. This document is just one part of a larger series of ATSDR guidance documents that outline approaches for evaluating exposures to environmental contamination. Moreover, the guidance applies to the calculation of TEQs for dioxin and DLCs based on environmental sampling data collected with discrete, composite, and incremental methods. This guidance does not apply to:

- *TEQ calculations for Polycyclic Aromatic Hydrocarbons (PAHs).* ATSDR is currently developing separate guidance that applies specifically to PAHs, and that guidance will explain the toxicity weighting scheme health assessors should apply for this separate class of chemicals. Health assessors who need to address PAHs before the chemical-specific EDG is available should consult with their ADS group about preferred approaches.

- *Calculating EPCs from multiple environmental samples.* ATSDR has developed separate guidance (e.g., ATSDR, 2019a; 2020a) that describes the process of calculating EPCs with discrete sampling data and non-discrete sampling data. After using this guidance to determine TEQ values for individual samples in an exposure unit, health assessors should then apply the other guidance documents to determine EPCs on a TEQ basis for the entire exposure unit.

While health assessors can use this guidance to calculate TEQs for dioxin and DLC data collected via any sampling strategy, they must use sampling specific guidance when calculating EPCs. ATSDR has developed EDGs to calculate EPCs for data collected with 1) discrete sampling (ATSDR, 2019a) and 2) composite and incremental sampling methodology (ISM) (ATSDR, 2020a).

1.3 Resources for Further Information

This guidance was developed to make TEQ calculations for dioxin and DLCs a straightforward process. For additional background information on the general EPA approach followed in this guidance, health assessors are referred to the following sources:

- United States Environmental Protection Agency's (USEPA's) User Guide Uniform Federal Policy Quality Assurance Project Plan Template for Soils Assessment of Dioxin Sites (EPA, 2011).
- USEPA's Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-like Compounds (USEPA, 2009).

Some health assessors may want to access additional resources for information on the advanced topics mentioned in this document. In those cases, health assessors should:

- Review Dr. Dennis Helsel's paper on estimating TEQs for dioxin and DLCs. (Helsel DR. Summing nondetects: Incorporating Low-Level Contaminants in Risk Assessment. Integr Environ Assess Manag. 2010 Jul;6(3):361-366.)
- Consult with their ADS group for other resources. ATSDR recommends this option to ensure that all health assessors consistently rely on a common approach when calculating TEQs, rather than having health assessors individually seeking input from different (and perhaps inappropriate or conflicting) sources.

1.4 How to Use This Guidance

Health assessors will find all TEQ guidance in this document's text. Appendix A includes a glossary of key terms, Appendix B presents example TEQ calculations, and Appendix C provides example sensitivity analyses. Additional information is provided in text boxes, as follows:

Key Point
Blue text boxes concisely summarize major elements of this TEQ guidance.

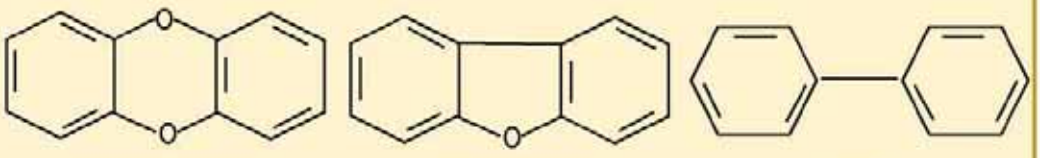
Additional Information
Yellow text boxes provide scientific background information on issues related to TEQ calculations.

2.0 BACKGROUND

The term "dioxin and DLCs" refers to a wide range of compounds in three chemical classes: polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzofurans (PCDF), and coplanar polychlorinated biphenyls (PCBs). These three chemical classes represent structurally (e.g., "non-ortho-" and "mono-ortho-" substitutions) and toxicologically similar halogenated aromatic hydrocarbons (USEPA, 2011). The individual compounds within each class are referred to throughout the remainder of this document as "congeners."

Congeners within these three chemical classes (e.g., PCDDs, PCDFs, and PCBs) have similar structures, but varying physical and chemical properties based on the position of chlorine atoms. PCDD and PCDF congeners have two benzene rings joined by a single or double oxygen bridge, while PCBs consist of two benzene rings joined by a carbon to carbon bond. Varying numbers of chlorines are attached to the carbons of the congeners, and congener names are assigned based on the position and number of those chlorine atoms. See the yellow box below for the basic structure of PCDDs, PCDFs, and PCBs.

Additional Information: Dioxin, Furan, and PCB Structures:



PCDDs (dioxins) PCDFs (furans) PCBs

While PCDDs, PCDFs, and PCBs comprise almost 420 individual congeners, only a small subset of these congeners are considered to have dioxin-like toxicity and are therefore included in TEQ calculations. Congeners with dioxin-like toxicity are those known to bind to the aryl hydrocarbon receptor (AhR) in humans and to elicit toxic or biochemical responses. Table 1 (found at the end of this guidance) lists these congeners—any PCDD, PCDF, or PCB congeners not listed in Table 1 should not factor into TEQ calculations.

Key Point: PCDDs, PCDFs, and PCBs with dioxin-like toxicity

Dioxin and DLC Groups	Total Number of Congeners	Number of Congeners with Known Dioxin-like Toxicity
PCDDs - Dioxins	75	7
PCDFs - Furans	135	10
PCBs	209	12

The term "dioxin and DLCs" refers to the seven PCDDs, ten PCDFs, and 12 PCBs with dioxin-like toxicity. Only these congeners are included in TEQ calculations.

2.1 What are TEQs and When to Use Them

TEQs provide a means for reducing measurements of numerous different congeners analyzed from one environmental sample to a single value that can be used for health assessment purposes. They are calculated to represent the overall toxicity of complex mixtures of PCDD, PCDF, and PBB congeners, relative to a single benchmark compound. In the case of dioxin and DLCs, the toxicity of each individual congener is weighted against that of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), historically considered the most toxic member of these chemical classes. Most dioxins and DLCs are thought to have lower toxicity than TCDD, except for 1,2,3,7,8-pentachlorodibenzo-p-dioxin, which is considered approximately equal in toxicity to 2,3,7,8-TCDD. Measured concentrations and detection limits of each

congener and the congeners' corresponding weighting factors are used to characterize the toxicity of dioxin and DLCs.

To calculate TEQs, toxic equivalent factors (TEFs) have been assigned to each dioxin and DLC congener. TEFs are assigned by comparing the relative toxicity of individual congeners by "order-of-magnitude" to that of 2,3,7,8-TCDD, based on detailed scientific review of chemical structures and toxicological databases. Currently, values range from 0.00003 to 1.0. A TEF of 0.1 indicates that the congener is $1/10^{th}$ as toxic as 2,3,7,8-TCDD, whereas a TEF of 1.0 indicates that the congener is equally as toxic as 2,3,7,8-TCDD.

TEF consensus values developed by the World Health Organization (WHO) and accepted by ATSDR are shown in Table 1, at the end of this guidance (Van den Berg et al., 2006). These are TEFs for mammalian species and should be used for all TEQ calculations by health assessors to support public health evaluations. The specific TEF values used represent order-of-magnitude relative toxicity increments, expressed on a logarithmic scale (USEPA, 2009). WHO periodically reviews and updates these values, and ADS groups will inform health assessors of any notable future updates. The most recent TEFs were developed in 2005. Note that EPA recommends that TEFs be used for all effects mediated through aryl hydrocarbon receptor binding by dioxin and DLCs, including cancer and noncancer effects (EPA, 2009).

To calculate the TEQ for an environmental sample, the concentrations of individual congeners are first multiplied by their respective TEFs to produce congener-specific toxic equivalent concentrations (TEC). The individual TECs are then summed to obtain a total TEQ for the sample. The two equations used to calculate TEQs are shown in the blue box below.

Key Point: How to calculate a TEQ

Equation 1:

$$TEC_i = x_i \times TEF_i$$

Equation 2:

$$TEQ = \sum_{i=1}^{k} (TEC_i)$$

Where:

- TEC_i is the toxic equivalent concentration of the i^{th} individual congener in the sample.
- x_i is the measured concentration of the i^{th} individual congener in the sample.
- TEF_i is the individual toxic equivalent factor.
- TEQ is the toxic equivalent for the environmental sample.
- k is the number of congeners that make up the TEQ.

While TEQs provide a useful technique to reduce measured concentrations of numerous congeners into a single value, health assessors should be familiar with the following underlying assumptions that went into developing TEFs, before applying them to public health evaluations (Safe, 1990).

1. The compounds exert toxicity through a common receptor-mediated mechanism.
2. The effects of the individual congeners within the mixtures are additive.
3. The individual congeners have similarly shaped dose-response curves.

Overall, the TEQ framework provides a scientifically justified, health protective, and widely accepted method for evaluating toxicity of mixtures of dioxin and dioxin-like compounds (NAS, 2006). However, the method has inherent uncertainties and may not capture the true health risks of all congener exposure scenarios.

3.0 GUIDANCE RECOMMENDATION: CALCULATING TEQS FOR A SINGLE SAMPLE

This section presents ATSDR's preferred approach to calculating TEQs for evaluating health implications of exposures to dioxin and DLCs. Since health assessors will frequently encounter data sets that include non-detect results, this section focuses largely on how to handle "censored data"— a term commonly used to describe data sets including non-detect observations. Health assessors should review this section and the example calculations shown in Appendix B and C before applying this guidance.

Key Point: General strategy for calculating TEQs with non-detect results

To calculate TEQs for an environmental sample, health assessors should:

- Review and prepare the data for TEQ calculations (Section 3.3).
- Calculate the TEQ using ATSDR's KMcalc macro function in Excel (Section 3.5).
- Complete sensitivity analyses to evaluate the influence of different methods to handle non-detects and rejected results (Section 3.6).

3.1 General Approach for Calculating TEQs

The general approach to calculate TEQs differs for environmental samples without non-detect observations (see Section 3.1.1) and with non-detect observations (Section 3.1.2). However, the same software applications (Section 3.2), data processing steps (Section 3.3), use of ATSDR's KMcalc Excel tool (Section 3.5), sensitivity analyses (Section 3.6), and quality control checks (Section 3.7) apply to both scenarios. The remainder of this section describes the general approach for data sets without and with non-detects.

3.1.1 Environmental Samples without Non-detect Observations

To illustrate the general TEQ computational approach shown in Section 2.1 and applicable to environmental samples without non-detect observations, this section presents a hypothetical soil sample in which seven DLCs were measured and all had detected concentrations. Refer to the text box later in this section for the specific values. To calculate the TEQ for this sample, the detected results for the seven dioxin congeners are first multiplied by applicable TEFs to calculate TECs, and then summed to calculate the TEQ for the sample.

In this example, the TEQ for the soil sample is 2.51 ng-TEQ/kg. The health assessor would first compare this TEQ concentration to the CV for 2,3,7,8-TCDD. If the TEQ concentration exceeds the CV, the TEQ would then be used in the health effects evaluation, following guidelines for 2,3,7,8-TCDD.

Note that the TEQ calculated this example is presented in units of ng-TEQ/kg. This is consistent with ATSDR's preferred approach for reporting the TEQ concentrations, as explained in the blue box below. Health assessors should report all calculated TEQs following this naming convention.

Additional Information: Example TEQ Calculations with Detected Results from a Single Soil Sample

Dioxin Congener	Analytical Result (ng/kg)	TEF [a] (unitless)	TEC [b] (ng/kg)
2,3,7,8-TCDD	1.7	1	1.7
1,2,3,7,8-PeCDD	0.18	1	0.18
1,2,3,4,7,8-HxCDD	0.26	0.1	0.026
1,2,3,6,7,8-HxCDD	2.1	0.1	0.21
1,2,3,4,6,7,8-HpCDD	25	0.01	0.25
1,2,3,7,8,9-HxCDD	0.77	0.1	0.077
OCDD	220	0.0003	0.066
		2,3,7,8-TCDD TEQ [c] = 2.51 ng-TEQ/kg	

Notes:

a. 2005 WHO TEFs as presented in Table 1 at the end of this guidance.
b. TEC for each congener = (Analytical Result) x (TEF).
c. 2,3,7,8-TCDD TEQ for sample = Sum of TECs for the seven detected congeners.

With this simple illustration, health assessors should recognize that TEQs are weighted sums of the individual congeners, with weights based on each congeners' relative toxicity to 2,3,7,8-TCDD. Another way to consider the result from the example above is that exposure to the measured concentrations of the seven different DLC congeners is essentially equivalent to exposure to 2.51 ng/kg of 2,3,7,8-TCDD.

Key Point: Reporting Calculated TEQs

Chemical concentrations are typically reported in units of mass of the chemical per mass or volume of the sampled media (e.g., air, soil, sediment, groundwater, etc.). Health assessors should report all calculated TEQs in units of measurement that include "TEQ" in the unit's numerator. This is particularly important so that TEQ results are not confused with congener-specific results. Several examples of this TEQ naming convention are shown below.

- Soil and sediment: pg-TEQ/kg and ng-TEQ/kg
- Indoor and outdoor air: pg-TEQ/m^3 and ng-TEQ/m^3
- Groundwater and surface water: pg-TEQ/L and ng-TEQ/L

This hypothetical example is only shown to illustrate the TEQ computational approach. In most cases, health assessors will encounter samples in which some dioxin and DLC congeners are detected and others are not. The following section reviews general approaches for those scenarios.

3.1.2 Environmental Samples with Non-detect Observations

Non-detects are valid measurements in which the concentration of the contaminant of interest is too low to measure with confidence. Sampling reports typically present non-detects as being less than a specified limit (e.g., "<25 ng/kg"), with that limit being either a method detection

limit or a quantification limit. In these cases, health assessors can only conclude that the actual contaminant level is somewhere between zero and the specified level. Nonetheless, non-detects still provide useful information and should be included in TEQs.

ATSDR's preferred approach to calculate a TEQ from an environmental sample with non-detect observations follows Dr. Dennis Helsel's approach of Kaplan-Meier (KM) estimation (Helsel, 2012). This non-parametric approach uses an unbiased framework for handling non-detect observations in TEQ calculations. Specific considerations for environmental samples with non-detect results are summarized in Section 3.4.

3.2 Software Applications

Health assessors should use the Excel macro function (KMcalc) developed by ATSDR to calculate TEQs for environmental samples with dioxin and DLC data. This macro function will calculate TEQs for samples without non-detects following the process described in Section 3.1. For samples with non-detect results, the macro will impute congener concentrations for non-detects with the KM method (where appropriate) and process data qualifiers per ATSDR procedures. In one rare exception (i.e., for samples with fewer than three detected results), the KMcalc macro cannot be used to calculate TEQS and health assessors are directed to Section 3.4.1. Details regarding how the TEQs are calculated for non-detects are presented in Section 3.4, instructions on how to use the KMcalc macro are provided in Section 3.5, and the process is demonstrated with an example data set in Appendix B.

Health assessors may notice that USEPA provides publicly available Microsoft Excel spreadsheet tools that calculate TEQs for dioxin and DLCs with the KM method. These tools, however, were designed to accommodate incremental sampling data (e.g., with inputs for triplicate sampling results) and therefore do not apply to all sampling scenarios; and other aspects of the TEQ calculations do not align with ATSDR's guidance (e.g., how to process environmental samples when the highest result is a non-detect). Health assessors are therefore encouraged to use ATSDR's calculation tool for determining EPCs.

3.3 Data Processing Steps

Regardless of whether a given sample includes non-detect results, health assessors should always complete the following two data processing steps:

- *Perform a data quality review.* Before proceeding with TEQ calculations, health assessors should review their environmental sampling data to confirm the data are of a known and high quality and meet the data quality objectives for the health evaluation in question. Any R-qualified (e.g., rejected) results should be removed from the data set. TEQs should never be calculated with R-qualified data.

  Health assessors should, however, take note of any R-qualified values that are removed from a data set to conduct subsequent sensitivity analyses. These analyses should be completed to ensure that the decision to exclude R-qualified data does not substantially impact the final TEQ. Sensitivity analyses are described in Section 3.6 and demonstrated in Appendix C, and should be completed whenever R-qualified results are removed.

- *Identify and process duplicate samples and replicate analyses.* Two commonly used approaches to characterize measurement precision in environmental samples are through analyzing

duplicate samples (i.e., two samples collected from the exact same place and time) or conducting replicate analyses of a single environmental sample (i.e., two separate laboratory analyses of the same sample). Health assessors should not use both measurements from duplicate samples or replicate analyses in health evaluations, because doing so artificially assigns greater weight to these samples or analyses. Instead, health assessors should reduce results from duplicate samples or replicate analyses into the result for a single sampling event.

For dioxin and DLCs, the preferred approach is to calculate TEQs for each duplicate sample or each replicate analysis, and then use the average of these TEQs to represent the single sampling event in CV comparisons and health evaluations. As an example, assume a laboratory received a single soil sample and analyzed that sample in replicate (i.e., the laboratory generated two different profiles of congener concentrations for the same sample). To determine the TEQ for this sample, health assessors should first calculate the TEQ for each replicate following the procedures outlined in this guidance; and then average the two TEQ values from the two replicates to determine the TEQ of the overall sampling event. This procedure should be applied for both duplicate samples and replicate analyses.

3.4 Special Considerations for Environmental Samples with Non-Detects

ATSDR's preferred approach to calculating TEQs for dioxin and DLCs for a single sample that includes non-detect results is to use the KM method. However, this method does not perform well for data sets with very few detected results (Helsel, 2010) and therefore should only be used to calculate TEQs for environmental samples with at least three detected congeners. For example, if a laboratory analyzed an environmental sample for 17 DLC congeners, the KM method should only be applied when at least three of those congeners have detected concentrations.

Section 3.4.1 describes the computational approaches for environmental samples with fewer than three detected congeners, and Section 3.4.2 describes the computational approaches for environmental samples with three or more detected congeners.

3.4.1 Calculating TEQs for Environmental Samples with Fewer than Three Detected Congeners

For an environmental sample with fewer than three detected congeners, the KM method should not be used. In this case, the total TEQ in the sample is uncertain, and will range between the sum of detected congeners and their respective TEFs and the sum of detected congeners times their respective TEFs, plus the detection limits of the non-detected congeners times their respective TEFs. The KMcalc spreadsheet and macro cannot be used to calculate a TEQ for such samples.

To calculate TEQs for samples with fewer than three detected congeners, health assessors should follow the calculations outlined in Section 2.1 (i.e., Equations 1 and 2). In these calculations, the maximal TEQ value is the detection limit and it is calculated from the sum of (1) the measured concentrations for the fewer than three congeners that were detected multiplied by their respective TEFs and (2) the full detection limit for the congeners that were not detected multiplied by their respective TEFs. Health assessors should find congener-specific detection

limits in the environmental sampling reports that present the measurements for dioxin and DLCs.

The resultant TEQ value should be U-qualified if TECs from non-detect records represent 80% or more of the sum of the TECs from all congeners (U-qualified data indicate that a sample was analyzed for a contaminant but the contaminant was not detected, and the concentration reported with the qualifier is the quantitation limit). For example, consider the sample TEQ calculated in Section 3.1.1, in which the resultant TEQ was 2.51 ng-TEQ/kg. For this example, suppose that only one of the congeners was detected rather than all of them. If only OCDD was detected, the resultant TEQ would be U-qualified because the OCDD TEC contributed only 2.6% of the sum of the TECs (0.066 ng/kg ÷ 2.51 ng/kg = 2.6%) and the remaining non-detect congeners contributed 97.4% of the sum. If, however, only 2,3,7,8-TCDD was detected, the resultant TEQ would not be U-qualified because 2,3,7,8-TCDD contributed 68% of the resultant TEQ and the remaining congeners contributed only 32%.

Health assessors should also examine whether the one or two detected congeners were measured at concentrations of potential health concern. If the detections were for any of the congeners listed in Section 1.1, health assessors should compare the measured concentrations of these congeners to their corresponding CVs.

3.4.2 Calculating TEQs for Environmental Samples with Three or More Detected Congeners

For environmental samples with at least three detected congeners, TEQs should be calculated with the KM method. However, in cases where the lowest TEC or the highest TEC is a non-detect, special considerations apply to the TEQ calculation. The KMcalc macro will account for these considerations, described here:

An environmental sample with the lowest TEC reported as a non-detect: If the lowest TEC across all congeners is a non-detect, the non-detect observation will be replaced with a detected concentration equal to the value of the detection limit, before calculating TEQs. If multiple non-detect records have the lowest TEC, this substitution should be performed for only one of the congeners. If multiple records with the lowest TEC are a mixture of detects and non-detects, no changes are required.

An environmental sample with the highest TEC reported as a non-detect: In the unlikely event that the highest TEC across all congeners is a non-detect, the TEQ will be calculated while considering this value a detected concentration at the detection limit. If multiple non-detect records have the highest TEC, this substitution should be performed for only one of the congeners. If multiple records with the highest TEC are a mixture of detects and non-detects, no changes are required.

Similar to the case of one or two detected congeners, the resultant TEQ will be presented as a non-detect with a U-qualifier if TECs from non-detect records represent 80% or more of the sum of the TECs from all congeners. When calculating these percentages, health assessors should use the original detect or non-detect status of each congener record. Any changes made to records associated with the highest or lowest TECs for the KM method calculations should not be considered when evaluating whether the resultant TEQ is U-qualified.

3.5 Calculating TEQs with ATSDR's KMcalc Macro in Excel

As described in Section 3.1, health assessors can use ATSDR's KMcalc macro to calculate TEQs for environmental samples with and without non-detect results. This single spreadsheet macro function applies Equations 1 and 2 (as shown in Section 2.1) for samples without non-detects and the KM method for samples with non-detects. In one rare exception (i.e., for samples with fewer than three detected results), the KMcalc macro cannot be used to calculate TEQS and health assessors are referred to Section 3.4.1.

The macro can be used in two ways: If health assessors are working with an existing Excel workbook that already contains dioxin and DLC analytical results, they can simply load the KMcalc macro into the workbook for TEQ calculations; or health assessors can transcribe or copy their sampling data into an Excel file that already has the macro loaded. Instructions on how to load the macro to Excel are provided in Appendix B, with options for "general users" and "advanced users." Health assessors who have questions about applying the macro should contact their ADS group.

The macro function calculates a TEQ and assigns a qualifier based on three inputs: concentrations (which may include detected values and detection limits for non-detect results), qualifiers (i.e., U-flags and J-flags), and TEFs. Health assessors must confirm that their Excel spreadsheets include these necessary data inputs. Refer to the example shown in Appendix B for instructions on how these three main inputs must be formatted for use with the KMcalc macro. The following list describes important considerations for each input:

- Congener Concentrations:
    - All inputs for congener concentrations must be numeric values. Symbols, letters (e.g., "<" or lab qualifiers in the concentration field), and extraneous blank spaces will result in formula errors.
    - All congener concentrations must be in the same units (e.g., ng/kg or ng/m^3), which is usually the case for environmental sampling data; meaning, laboratories typically will not use two different units of measurement when reporting concentrations for congeners within a single environmental sample. These units, however, should not be entered with congener concentrations in the spreadsheet macro; the KMcalc function will return an error when units are typed into the concentration field. The calculated TEQ will be in the same units as the individual congener concentrations.
    - Congener data do not need to be sorted.
- Concentration Qualifiers:
    - TEQ calculation spreadsheets should include any U, J, or UJ qualifiers assigned by the analytical laboratory, as the KMcalc macro has unique computational approaches for U-qualified and J-qualified data. These qualifiers must be entered into the spreadsheet as capital letters and any extraneous spaces in the qualifier

data will result in computational errors. (Note: Appendix B.1 explains an exception to this guidance for the "general user" calculations.)

- A U qualifier (entered as a capital letter) must be entered for all non-detect observations. This is because the computational algorithm recognizes the "U" as a non-detect observation. Use of any other letter (or letters) for non-detects will result in erroneous calculations. Therefore, in cases where a laboratory uses other letters or conventions to represent non-detects (e.g., some laboratories might report them as "ND" or "<MDL"), health assessors must replace those notations with U when using the KMcalc macro. Similarly, a J qualifier (entered as a capital letter) must be entered for all estimated observations. The KMcalc macro only recognizes "J" as an estimated value. Health assessors may encounter data with a wide range of data qualifying conventions, including use of multiple qualifiers for a single measurement. Any questions regarding data qualifiers in the context of KMcalc should be directed to ADS groups.

- Toxic Equivalent Factors – TEFs: Health assessors must enter the congener-specific TEFs from Table 1 (at the end of this guidance document) into the spreadsheet before calculating TEQs. (Note: Appendix B.1 explains an exception to this approach for the "general user" calculations.)

Once data are properly entered to Excel, health assessors can use the KMcalc function in just the same way as any other Excel function (e.g., average, min, max, etc.). The KMcalc function can be selected through Excel's Insert Function button or by entering the formula function directly into an empty cell =KMcalc(Conc,Qualifiers,TEF,ResultType). Both processes are described in detail in Appendix B.2 and the required function inputs are presented in the blue box below.

For every environmental sample requiring a TEQ calculation[1], health assessors should use KMcalc for two purposes: (1) to calculate the TEQ and (2) to determine whether the TEQ result should have a qualifier. The KMcalc macro will output a TEQ value when the health assessor enters "Sum" in the "ResultType" field of the equation, and the KMcalc macro will output a qualifier when the health assessor enters "Qualifier" in the "ResultType" field of the equation. (Note: The "general user" example in Appendix B.1 presents a simplified way for obtaining the TEQ results.) There is only one scenario possible for the KMcalc-assigned qualifiers. If the contribution of TECs to the TEQ from congener results that are U-, J-, or UJ-qualified is greater than 50 percent, the KMcalc function will return a J-qualifier. The KM-calc function does not assign U-qualifiers.

[1] In one rare exception (i.e., for samples with fewer than three detected results), the KMcalc function cannot be used to calculate TEQS and health assessors are directed to Section 3.4.1.

Before using the outputted TEQ for public health evaluations, health assessors should first complete the sensitivity analyses described in Section 3.6.

Key Point: KMcalc Function

The KMcalc function is as follows:

=KMcalc(Conc,Qualifier,TEF,ResultType)

Where:

- *Conc* is the range of spreadsheet cells that have the measured concentrations of detected congeners or full detection limits of non-detect congeners. Remember to only consider congeners included in the TEQ.
- *Qualifier* is the range of spreadsheet cells with data qualifiers (U, J, UJ, or blank) for the corresponding congener concentrations.
- *TEF* is the range of spreadsheet cells with the congener-specific toxic equivalent factors.
- *ResultType* is the desired output:
  - If "Sum" is entered, the KMcalc function will output the TEQ.
  - If "Qualifier" is entered, the KMcalc will output the qualifier that should be assigned to the calculated TEQ.

As Appendix B.2 explains, advanced users must run the KMcalc function twice—one for each ResultType—to obtain the estimated TEQ and TEQ-qualifier. That means that the formula must be entered once with the ResultType set to "Sum," and then again with the ResultType set to "Qualifier." However, general users can follow the procedures in Appendix B.1, which are more straightforward.

3.6 Sensitivity Analyses

Health assessors should complete two sensitivity analyses to ensure that the initial TEQ estimate is not heavily influenced by the KM method used to handle non-detects or by exclusion of R-qualified results. These analyses are described below and demonstrated in Appendix C.

- *Sensitivity Analyses for Handling Non-Detects.* Health assessors should use the KM method for all dioxin and DLC TEQ calculations for data sets containing non-detect results. However, to confirm that the initial TEQ is not heavily influenced by the KM method, the initial estimate should be compared to lower- and upper-bound TEQ estimates with the following two substitution methods:

- Lower-bound TEQ estimate: Substitute all non-detect congeners with a detected value set to zero. This is done in the calculation spreadsheet by setting the concentrations for all non-detect observations to zero, removing the U flag in the qualifier field, and using KMcalc to determine the TEQ for this scenario.

- Upper-bound TEQ estimate: Substitute all non-detect congeners with a detected value set to the detection limit. This is done in the calculation spreadsheet by setting the concentrations for all non-detect observations to their detection limits, removing the U flag in the qualifier field, and using KMcalc to determine the TEQ for this scenario.

Additional Information: Sensitivity Analysis

The sensitivity analyses described in Section 3.6 are steps the health assessor must take to determine whether the TEQ value calculated according to the guidance is acceptable to use for health assessment purposes. *The health assessor should not use the sensitivity analysis TEQs for their health evaluations.* The appropriate TEQ to use in health evaluations are calculated following procedures in Section 3.1.1 (for samples without non-detect observations) and using the KMcalc spreadsheet (for samples with non-detect observations).

For both the upper-bound and lower-bound TEQ estimates, health assessors should make substitutions based on whether each congener record was a non-detect in the original dataset. Changes to the detection status of records with the lowest or highest TEC made before completing the KM method calculations should be ignored in these sensitivity analyses.

Once these additional TEQs have been calculated, health assessors should compare the highest estimated TEQ to the lowest estimated TEQ by calculating the relative percent difference (RPD) between the two values. An RPD of greater than 50 percent suggests the method for replacing non-detects has an unacceptably large influence on the results. In this case, health assessors should consult with their ADS group on how to proceed. If the RPD is less than 50 percent, health assessors should proceed with CV comparisons and health effects evaluations using the initially calculated TEQ. The equation to calculate the RPD between two values is shown in Equation 3.

Equation 3:

$$\text{RPD} = \left(\frac{|Value_1 - Value_2|}{(Value_1 + Value_2) \div 2)} \right) \times 100$$

Health assessors who are working in ATSDR's spreadsheet that already has the KMcalc macro loaded will be provided with the results of this sensitivity test along with the TEQ concentration and qualifier. Refer to Appendix B.1 and Appendix C for more detail.

- *Sensitivity Analyses for Handling R-qualified Data (e.g., rejected).* As described in Section 3.3, R-qualified data should never be included in initial TEQ estimates. However, to confirm that exclusion of R-qualified results does not have an unacceptably large influence on the TEQ, health assessors should compute the TEQ while including the rejected results and then estimate the RPD between this value and the initial TEQ estimate. This computation can only be performed if a concentration was included with the R-qualified results. If the RPD is less than 50

percent, health assessors should proceed with CV comparisons and health effects evaluations using the initially calculated TEQ.

If the RPD exceeds 50 percent and the TEQ including the R-qualified value is at a level of health concern, health assessors should still use the initial TEQ in the health evaluation but acknowledge the limitations associated with excluding the rejected value. The health assessor should also consider whether additional sampling is needed to reduce the uncertainties associated with the rejected values. Influence of rejected results will be greatest when congeners with relative high toxicity (e.g., a TEQ close to 1.0) are R-qualified.

3.7 Quality Control Checks

Health assessors are encouraged to have a colleague double-check their calculations. It is always good practice to have colleagues review calculations that support PHA conclusions, especially TEQ calculations used in health effects evaluations. To facilitate this review, health assessors should document their calculations—presumably in the KMcalc spreadsheet—and ask an experienced colleague to replicate the results.

3.8 Special Considerations

While ATSDR developed this guidance to apply to a broad range of site-specific scenarios, some environmental data sets will present unique challenges for calculating TEQs. In general, health assessors should consult with their ADS group when they encounter any site-specific scenarios or other circumstances not sufficiently covered by the general practice presented earlier in this section. Health assessors should also discuss with their ADSs group how to handle estimated maximum probable concentration (EMPC) data when calculating TEQs with their ADS group. These data are briefly described below.

Some dioxin results may contain EMPC values (e.g., when a congener peak is present at an acceptable signal-to-noise ratio, but ion abundance criteria are not met for definitive identification of that congener) (USEPA, 2011). These data are generally further qualified with a "J" flag for values that are estimated and a "U" flag for non-detect values. In general, "J" flagged EMPC values may be treated as qualified results, and U-qualified results may be considered non-detected values, and used in TEQ calculations following the process prescribed in Sections 3.3 to 3.5. However, given that EMPC values may overestimate the TEQ, a sensitivity analysis should be performed to assess the influence of EMPC results on calculated TEQs (USEPA 2011). Health assessors should perform a sensitivity analysis by calculating TEQs while excluding all EMPC values. When estimated TEQs are considerably different with and without these data, health assessors should contact their ADS group on how to proceed.

4.0 REFERENCES

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Table 1. WHO 2005 Mammalian TEFs for Dioxin and DLCs

CAS Number	Full Congener Name	Shorthand Congener Name[1]	TEF[2]
Dioxin Congeners			
1746-01-6	2,3,7,8-Tetrachloro dibenzo-p-dioxin	2,3,7,8-TCDD	1
40321-76-4	1,2,3,7,8-Pentachloro dibenzo-p-dioxin	1,2,3,7,8-PeCDD	1
39227-28-6	1,2,3,4,7,8-Hexachloro dibenzo-p-dioxin	1,2,3,4,7,8-HxCDD	0.1
57653-85-7	1,2,3,6,7,8-Hexachloro dibenzo-p-dioxin	1,2,3,6,7,8-HxCDD	0.1
19408-74-3	1,2,3,7,8,9-Hexachloro dibenzo-p-dioxin	1,2,3,7,8,9-HxCDD	0.1
35822-46-9	1,2,3,4,6,7,8-Heptachloro dibenzo-p-dioxin	1,2,3,4,6,7,8-HpCDD	0.01
3268-87-9	1,2,3,4,6,7,8,9-Octachloro dibenzo-p-dioxin	OCDD	0.0003
Furan Congeners			
51207-31-9	2,3,7,8-Tetrachloro dibenzofuran	2,3,7,8-TCDF	0.1
57117-41-6	1,2,3,7,8-Pentachloro dibenzofuran	1,2,3,7,8-PeCDF	0.03
57117-31-4	2,3,4,7,8-Pentachloro dibenzofuran	2,3,4,7,8-PeCDF	0.3
70648-26-9	1,2,3,4,7,8-Hexachloro dibenzofuran	1,2,3,4,7,8-HxCDF	0.1
57117-44-9	1,2,3,6,7,8-Hexachloro dibenzofuran	1,2,3,6,7,8-HxCDF	0.1
72918-21-9	1,2,3,7,8,9-Hexachloro dibenzofuran	1,2,3,7,8,9-HxCDF	0.1
60851-34-5	2,3,4,6,7,8-Hexachloro dibenzofuran	2,3,4,6,7,8-HxCDF	0.1
67562-39-4	1,2,3,4,6,7,8-Heptachloro dibenzofuran	1,2,3,4,6,7,8-HpCDF	0.01
55673-89-7	1,2,3,4,7,8,9-Heptachloro dibenzofuran	1,2,3,4,7,8,9-HpCDF	0.01
39001-02-0	1,2,3,4,6,7,8,9-Octachloro dibenzofuran	OCDF	0.0003
PCB Congeners			
32598-13-3	3,3',4,4'-Tetrachlorobiphenyl	3,3',4,4'-tetraCB (PCB 77)	0.0001
70362-50-4	3,4,4',5-Tetrachlorobiphenyl	3,4,4',5-tetraCB (PCB 81)	0.0003
32598-14-4	2,3,3',4,4'-Pentachlorobiphenyl	2,3,3',4,4'-pentaCB (PCB 105)	0.00003
74472-37-0	2,3,4,4',5-Pentachlorobiphenyl	2,3,4,4',5-pentaCB (PCB 114)	0.00003
31508-00-6	2,3',4,4',5-Pentachlorobiphenyl	2,3',4,4',5-pentaCB (PCB 118)	0.00003
65510-44-3	2,3',4,4',5'-Pentachlorobiphenyl	2',3,4,4'5-pentaCB (PCB 123)	0.00003
57465-28-8	3,3',4,4',5-Pentachlorobiphenyl	3,3'4,4',5-pentaCB (PCB 126)	0.1
38380-08-4	2,3,3',4,4',5-Hexachlorobiphenyl	2,3,3',4,4',5-hexaCB (PCB 156)	0.00003
69782-90-7	2,3,3',4,4',5'-Hexachlorobiphenyl	2,3,3',4,4',5'-hexaCB (PCB 157)	0.00003
52663-72-6	2,3',4,4',5,5'-Hexachlorobiphenyl	2,3',4,4',5,5'-hexaCB (PCB 167)	0.00003
32774-16-6	3,3',4,4',5,5'-Hexachlorobiphenyl	3,3',4,4',5,5'-hexaCB (PCB 169)	0.03
39635-31-9	2,3,3',4,4',5,5'-Heptachlorobiphenyl	2,3,3',4,4',5,5'-heptaCB (PCB	0.00003

Notes:

1. PCBs are named by the number and position of the chlorine atoms around the biphenyl ring. They are also sometimes referred to by their specific congener number, as shown in parentheses. For example, 3,3',4,4'-tetrachlorobiphenyl may be referred to by the shorthand name of 3,3',4,4'-TCB or PCB-77.
2. Source: Mammalian TEFs as published in Van den Berg M, Birnbaum LS, Denison M, De Vito M, Farland W, Feeley M, et al. 2006. The 2005 World Health Organization re-evaluation of human and mammalian toxicity equivalency factors for dioxins and dioxin-like compounds. Toxicol Sci. 2006 Oct;93(2):223-241.

Appendix A. Glossary

Censored Data: A term commonly used to describe data sets including non-detect observations.

Detection Limit. For environmental sampling, detection limits (often referred to as method detection limits) are thresholds below which measured concentrations are not significantly different from a blank signal, at a specified level of probability. Measurements above detection limits are evidence of a nonzero signal at a given probability, confirming that the analyte of interest is present in the sample.

Environmental Sample. A collected quantity of air, water, soil, food, or other media in which contamination levels are measured, whether directly in the field or at a laboratory.

Estimated maximum probable concentration (EMPC). Some dioxin results may contain EMPC values. This designation is used when a congener peak is present during laboratory analysis at an acceptable signal-to-noise ratio, but ion abundance criteria are not met for definitive identification of that congener (USEPA, 2011). These data should still be used in the public health assessment process, and they are generally further qualified with a "J" flag for values that are estimated and a "U" flag for non-detect values.

Exposure Point Concentration (EPC). The representative contaminant concentration within an exposure unit or area in an exposure pathway to which receptors are exposed for acute, intermediate, or chronic durations during the past, present, or future.

Dioxin-like. Dioxin-like compounds are structurally related groups of chemicals from the family of halogenated aromatic hydrocarbons. In this group, we include chlorinated dibenzo-p-dioxins, chlorinated dibenzofurans, and certain PCBs that have dioxin-like structural characteristics ("non-ortho-" and "mono-ortho-" substitutions).

Kaplan-Meier (KM). Kaplan-Meier is a non-parametric standard method for calculating statistics for data sets included censored data. In the context of this guidance, Kaplan-Meier method should be applied when calculating TEQs for an environmental sample that has non-detect observations with different values of the detection limit.

Non-parametric methods. Non-parametric methods are statistical methods that do not assume data have a known shape or distribution. These methods can be applied with little information about the underlying distribution, including instances where details of the data distribution are not known. In this guidance, health assessors use non-parametric Kaplan-Meier methods to estimate toxicity equivalents for data sets with non-detect results.

Toxic Equivalent Concentration (TEC). The TEC is calculated as a congener's concentration multiplied by its TEF. The TEC is calculated as an intermediate step of the TEQ estimation.

Toxic Equivalent Factor (TEF). The TEF is based on the relative potency of the compound to the benchmark compound. A TEF of 0.1 indicates that the compound is $1/10^{th}$ as toxic as the benchmark compound, while 1 indicates that it is as toxic as the benchmark compound

Toxic Equivalents (TEQ). Calculated values that represent the overall toxicity of a complex mixture of congeners, relative to a single benchmark compound (e.g., the most toxic compound in that family).

Appendix B. Example TEQ Calculations in Microsoft Excel with KMcalc Macro

This example demonstrates the preferred approach for calculating TEQs using ATSDR's Microsoft Excel KMcalc macro function. The data set considered in this example includes 17 congeners measured in a single soil sample (Helsel, 2010), and are presented in the table below. Health assessors who are using the KMcalc macro for the first time are encouraged to replicate this example before using the macro to calculate TEQs for site-specific scenarios. The remainder of this example follows the process outlined in Section 3.0. All figures are screen shots from Excel in Microsoft Office 365™.

Congener Name	Concentration (ng/kg)[a]
1,2,3,4,6,7,8-HpCDD	25
1,2,3,4,6,7,8-HpCDF	1.8
1,2,3,4,7,8,9-HpCDF	<0.56
1,2,3,4,7,8-HxCDD	0.26
1,2,3,4,7,8-HxCDF	<0.6
1,2,3,6,7,8-HxCDD	2.1
1,2,3,6,7,8-HxCDF	0.33
1,2,3,7,8,9-HxCDD	0.77
1,2,3,7,8,9-HxCDF	0.37
1,2,3,7,8-PeCDD	0.18
1,2,3,7,8-PeCDF	0.24
2,3,4,6,7,8-HxCDF	<0.14
2,3,4,7,8-PeCDF	<0.8
2,3,7,8-TCDD	1.7
2,3,7,8-TCDF	5.1
OCDD	220
OCDF	44

Notes:

a. data as presented in Helsel, D (2010).
"<" indicates that result was not detected. The value presented is the full detection limit.

ATSDR has developed the KMcalc macro and spreadsheet for two different categories of Excel users: a general user and an advanced user. The general user is encouraged to work with "Option 1" in the KMcalc spreadsheet to determine TEQs for a single sample. General users should refer to Appendix B.1 for instructions on how to do so. The advanced Excel user may elect to import the KMcalc macro into other spreadsheets and apply the macro accordingly. This user should refer to Appendix B.2 for instructions on how to apply the macro. Health assessors who have questions about applying the macro should contact their ADS group.

Note that the KMcalc macro can be used to calculate TEQs for datasets with and without non-detects. In one rare exception (i.e., for samples with fewer than three detected results), however, the spreadsheet cannot be used to calculate TEQS and health assessors are directed to Section 3.4.1.

Appendix B.1: Instructions for the General User

The general user is encouraged to use "Option 1" of the KMcalc spreadsheet. This option has a few key benefits. First, health assessors need not manually enter the TEF values in the spreadsheet. This option has the TEF values coded into the file. Provided the health assessor uses the correct spelling for the congeners, the spreadsheet will automatically populate the TEF values after the congener names are entered. Second, once the congener names, concentrations, and qualifiers are entered and the user clicks "Run TEQ Calculations," the spreadsheet instantly generates all necessary outputs (which would otherwise have to be generated manually in "Option 2"). The one limitation of this option is that it may prove inefficient in cases where health assessors need to calculate TEQs for large numbers of samples. In such cases, the second KMcalc option (see Appendix B.2) may save time.

Three spreadsheets in this KMcalc file contain all information needed for TEQ calculations according to "Option 1." The health assessor enters the relevant inputs for a single sample, and the spreadsheet outputs the TEQ value, the qualifier that should be applied to the TEQ value (if any), the units for the TEQ, and whether the TEQ calculation passed the non-detect sensitivity analysis test referred to in Section 3.6 of this guidance. The "Option 1" spreadsheets include:

- "Option 1 – Instructions": This spreadsheet lists the three steps to conduct a TEQ calculation for a single sample. More details on the required data entry steps are listed in the next bulleted item. Upon opening the spreadsheet, users might be prompted to "enable macros." Macros must be enabled to run the "KMcalc" function and perform the TEQ calculations.

- "Option 1 – Calculations": After the health assessor enters the congener-specific environmental data into this spreadsheet and clicks "Run TEQ Calculations", key outputs appear in the orange-shaded cells, provided the user entered the sampling data according to the following specifications:

    - Only enter data in the blue-shaded cells. The spreadsheet includes blue-shaded cells where the date, site name, sample media, notes, concentration units, congener names, congener concentrations, and data qualifiers should be entered. Do not insert new rows or delete existing rows. Some interim values for the calculations appear in hidden cells.
    - Enter a separate row for every dioxin or dioxin-like compound that was measured in the sample, including those with non-detect results. Do not include blank rows between entries.
    - The "shorthand congener name" in the first column must exactly match one of the congener names listed in the "Option 1 – TEF Values" spreadsheet, which lists the current universe of 29 congeners and corresponding TEF values that have been approved for these calculations. A pop-up error message will appear if a shorthand congener name is entered incorrectly. If this occurs, check to make sure congener names have been entered correctly, with no typographical errors or extra spaces. Shorthand congener names may also be selected from those provided in the drop-down lists found in each cell of the first column. Upon entering shorthand congener names in the first column, the congener's category, CAS number, and full name will automatically populate the following three columns. Note that this spreadsheet only calculates TEQs

for the congeners listed in "Option 1 – TEF Values." Consult with you ADS group if a congener of interest does not appear on the list.

- In the "concentration" field, enter a numerical value for every congener that was evaluated. That numerical value should be the measured concentration for detected congeners and the method detection limit for non-detect observations. Every row with a congener name must have an entry in this column. Be sure to enter data in the same units of measurement for every congener. Congener concentrations entered as negative values or zero will result in a pop-up error message.
- In the "qualifier" field, only four options are allowed for each congener: U, J, UJ, or nothing. Enter the corresponding qualifier for every measurement from this list. Note that "U" refers to non-detect observations, "J" refers to estimated values, and "UJ" refers to estimated values below the detection limit. These qualifiers must be entered as capital letters; any other entries will result in a pop-up error message. Qualifiers may also be selected from those provided in the drop-down lists of each cell in this column.
- After completing all data entry steps, click "Run TEQ calculations" and save the spreadsheet. The entries in the orange-shaded cells in rows 4 through 7 present the final results. Those include the TEQ value for the sample (row 4), the units for the calculated TEQ (row 5), the qualifier to use for the TEQ value (row 6), and whether the TEQ calculation passed the non-detect sensitivity test outlined in Section 3.6 of this guidance (row 7). (Note: If no qualifier is needed for the calculated TEQ value, then "no qualifier" will appear in the orange-shaded cell in row 6.)

- "Option 1 – TEF Values": This spreadsheet lists the TEFs that ATSDR has approved for TEQ calculations for dioxin and DLCs. It is included for reference purposes only, and entries should not be changed. The spreadsheet can be useful in cases where a "check congener spelling" error appears in column D.

Appendix B.2: Instructions for the Advanced Excel User

The advanced Excel user may choose to follow this second option for calculating TEQ values. In this option, the user must enter the equations for the KM calculations. This allows for greater flexibility and can save time when calculating TEQs for numerous samples at once. However, in this option, health assessors also must enter TEF values on their own—and therefore must take great care in that process to ensure that correct values are used. Additionally, health assessors must run separate calculations for the TEQ values, the qualifiers, and the sensitivity analyses (and all three calculations are performed automatically for the first option). The process for using the second option for advanced users is outlined below in a series of four steps.

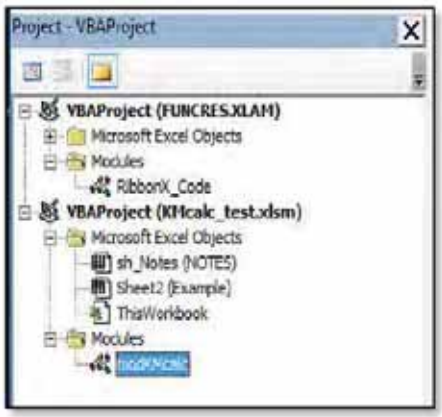
Step One: Loading KMcalc macro to Excel

The KMcalc macro is written in Visual Basic for Applications (VBA) for Excel. Health assessors may access the KMcalc macro in one of two ways: (1) save a copy of the example spreadsheet that already has the macro loaded and enter new site-specific data or (2) import the VB module (modKMcalc.bas) to an existing file that contains the environmental data. Both options are described below:

Option 1: If you chose to use the example spreadsheet that already has the macro loaded, you must enable macros through Excel's Trust Center Settings. To do so, go into Excel's File menu and select → Options → Trust Center → Trust Center Settings → Macro Settings → Disable Macros with Notification. This will force Excel to present a notification each time you open the Excel file (as shown below). You must select "Enable Content" from this pop-up window to use any macros.

Option 2: If you chose to load the macro to an existing spreadsheet that already contains the analytical data, follow the directions below:

1. Open the existing spreadsheet that contains your analytical data and save the file as an Excel Macro-Enabled Workbook (.xlsm).
2. Open the Visual Basic (VB) Editor by simultaneously clicking the "Alt" key and "F11" key on your keyboard.
3. Import the macro "modKMcalc.bas" by first selecting the VBA Project with the name of your file in the left upper portion of the window. Then select File → Import file, and locate the KMcalc VB module (modKMcalc.bas).
4. "ModKMcalc" will now appear in the VBA Project window, as shown in the screenshot below. Once "modKMcalc" appears in this window, you can use the KMcalc function in any cell of your data spreadsheet.



Step Two: Initial Data Processing Steps

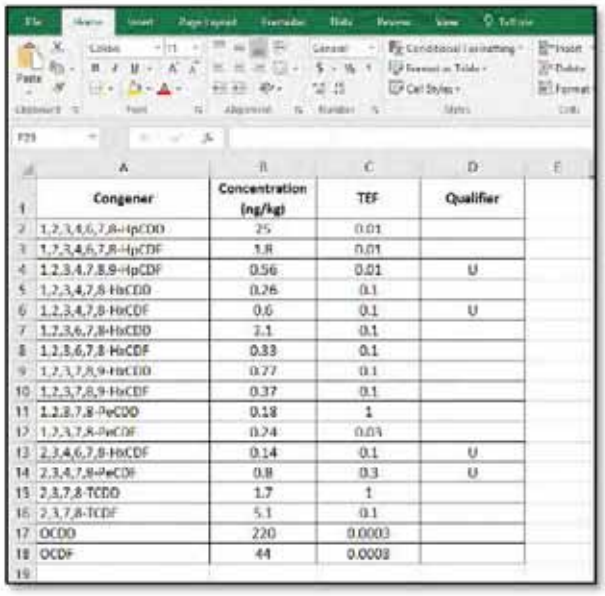
1. *Perform a data quality review.* In this example, it is assumed that the data are of a known and high quality and meet all data quality objectives for the health evaluation in question. There are no R-qualified (e.g., rejected) results and therefore no data must be removed from the spreadsheet before calculating the TEQ.

2. *Identify and process duplicate samples and replicate analyses.* The example data set is for a single sample without replicate or duplicate analysis, and no further data processing is required.

Step Three: Prepare data in Excel for TEQ Calculations

This example includes concentrations for 17 congeners, four of which are reported as non-detect. As described in Section 3.4, the KM method can be used to calculate TEQs for data sets with non-detect results, if there are least three detected concentrations. The data for this environmental sample meets this criterion and the KMcalc macro will apply the KM method.

The data was entered to Excel, as shown in the screenshot below. Note that this spreadsheet includes the necessary KMcalc function inputs: congener concentrations, qualifiers, and TEFs. Any concentration shown in the original data table above with a "<" (e.g., indicating a non-detect result) is included in the Excel spreadsheet with a U-qualifier.



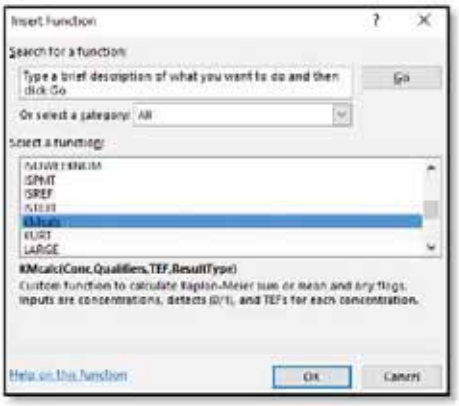
	A	B	C	D	E
1	Congener	Concentration (ng/kg)	TEF	Qualifier	
2	1,2,3,4,6,7,8-HpCDD	25	0.01		
3	1,2,3,4,6,7,8-HpCDF	1.8	0.01		
4	1,2,3,4,7,8,9-HpCDF	0.56	0.01	U	
5	1,2,3,4,7,8-HxCDD	0.26	0.1		
6	1,2,3,4,7,8-HxCDF	0.6	0.1	U	
7	1,2,3,6,7,8-HxCDD	2.1	0.1		
8	1,2,3,6,7,8-HxCDF	0.33	0.1		
9	1,2,3,7,8,9-HxCDD	0.77	0.1		
10	1,2,3,7,8,9-HxCDF	0.37	0.1		
11	1,2,3,7,8-PeCDD	0.18	1		
12	1,2,3,7,8-PeCDF	0.24	0.03		
13	2,3,4,6,7,8-HxCDF	0.14	0.1	U	
14	2,3,4,7,8-PeCDF	0.8	0.3	U	
15	2,3,7,8-TCDD	1.7	1		
16	2,3,7,8-TCDF	5.1	0.1		
17	OCDD	220	0.0003		
18	OCDF	44	0.0003		
19					

Step Four: Calculate the TEQ

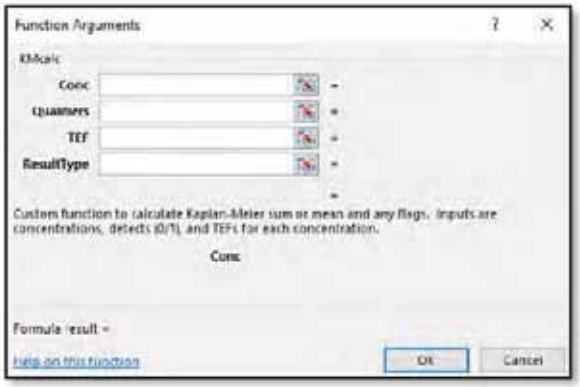
As described in Section 3.5, the KMcalc function can be used by either selecting Excel's Insert Function button and highlighting the necessary data or entering the formula directly into an empty cell. Detailed instructions for both methods are provided below.

1. *Using Excel's Insert Function button.* The KMcalc formula can be calculated in any cell of the spreadsheet by clicking on that cell and using Excel's Insert Function option. Once the required inputs and outputs are selected, the calculated value will appear in the selected cell. To launch

the Insert Function dialog box, users can either click the "Insert Function" button in the "Formulas" tab of the Excel ribbon, or click the "fx" (function) button in the Formula Bar. Users must then find and select the KMcalc function and click "OK." A screenshot of the search tool for Excel functions is shown below.



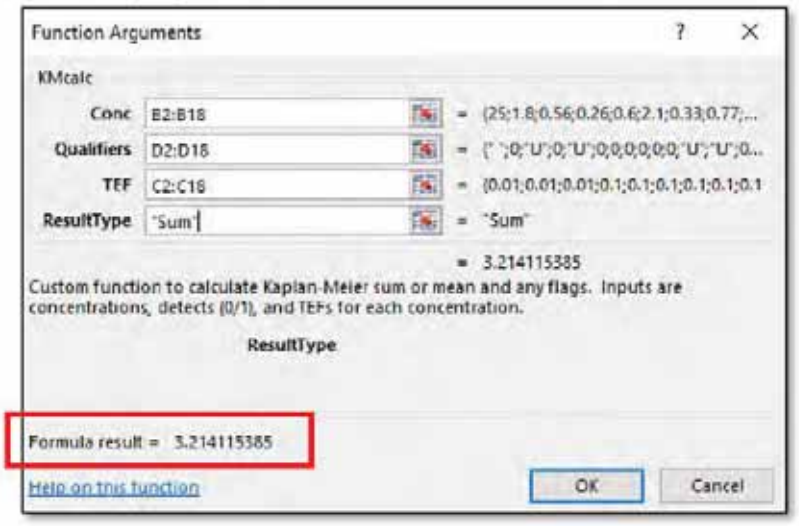
In the KMcalc Function box, the required arguments/inputs are defined by clicking on the small red, white, and blue button to the right of each argument and then highlighting the appropriate data in the Excel spreadsheet. A screenshot of the KMcalc function box is shown below.



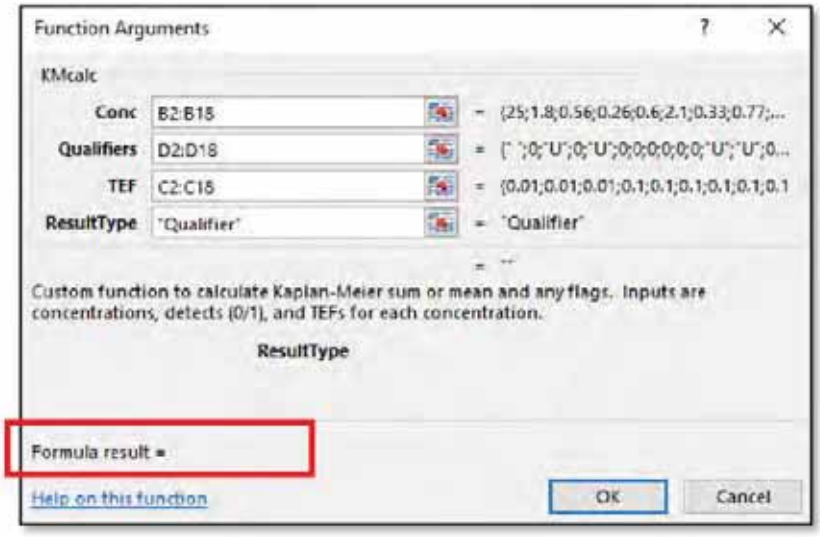
In this example, congener concentrations are located in cells B2 through B18, congener qualifiers are located in cells D2 through D18, and congener TEFs are located in cells C2 through C18. Health asssessors would select the function arguments as shown in the Function Arguments dialog box screenshots below. Health assessors are reminded that the function must be run twice; once with the ResultType set to "Sum" (e.g., to calculate the TEQ) and then again with the ResultType set to "Qualifier" (e.g., to determine what, if any, qualifier should be assigned to the calculated TEQ).

After the inputs are entered and "OK" is selected, the macro will return the result (whether a calculated TEQ or the TEQ qualifier) to the empty cell. A preview of the requested result is presented in the bottom left-hand corner of the Function Arguments dialog box.

Function Arguments for the *TEQ*:



Function Arguments for the *TEQ-Qualifier*:



In the first screenshot, the function is requesting the ResultType "Sum" (e.g., the TEQ), and that value is shown at 3.21 ng-TEQ/kg. In the second screenshot, the function is requesting the ResultType "Qualifier", and that value is shown as a blank result.

In this example, the 2,3,7,8-TCDD TEQ is calculated at 3.21 ng-TEQ/kg, with no qualifiers.

2. *Entering the function formula directly into an empty cell.* Alternatively, the KMcalc formula function can be entered to any empty cell in the spreadsheet. This requires typing the formula into an empty cell and selecting the appropriate range of cells for each required input. The KMcalc function formula is as follows:

= KMcalc(Conc,Qualifier,TEF,ResultType)

When typing the "Conc" part of the formula, one must enter the range of the cells that contain the congener concentrations. Similarly, when typing the "Qualifier" and "TEF" parts of the formula, one must enter the range of cells where these data are found. The KMcalc formula will return the calculated ResultType to the cell where the formula was entered. Health assessors must run the function once with the ResultType set to "Sum" and then again with the ResultType set to "Qualifier."

For this example, the inputs for the KMcalc formula require the following cell ranges:

- Conc = B2:B18 (The congener concentrations are found in cells B2 through B18).
- Qualifier = D2:D18 (The congener qualifiers are found in cells D2 through D18).
- TEF = C2:C18 (The congener TEFs are found in cells C2 through C18).
- ResultType = "Sum" and "Qualifier" (The two required outputs must be run separately).

The KMcalc functions would therefore be entered to separate empty cells as:

=kmcalc(B2:B18,D2:D18,C2:C18,"Sum")

=kmcalc(B2:B18,D2:D18,C2:C18,"Qualifier")

The KMcalc function will output the following results for this sample:

- Sum = 3.21
- Qualifier = *[blank cell]*

In this example, the TEQ is calculated at 3.21 ng-TEQ/kg with no qualifiers.

Appendix C. Example Sensitivity Analyses

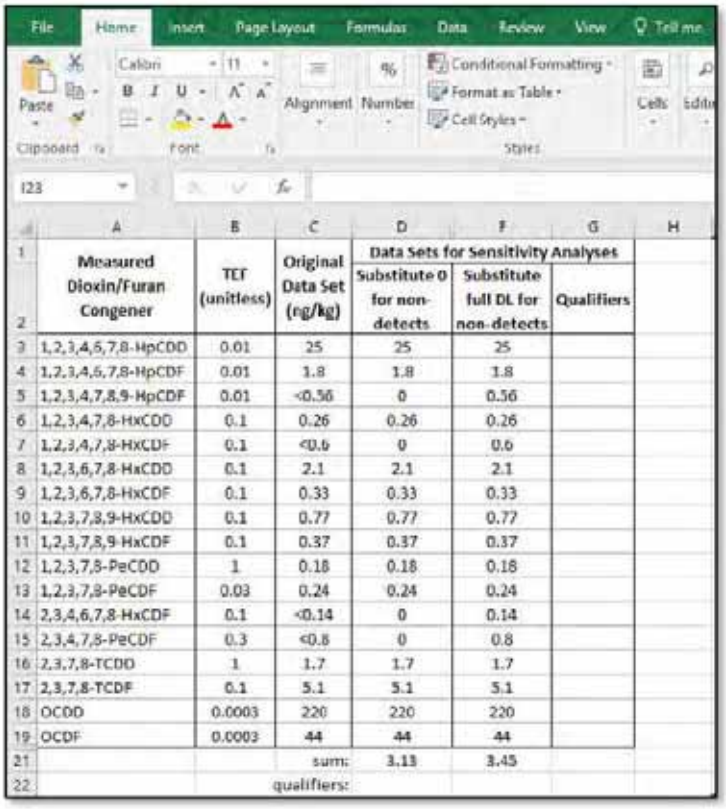
As described in Section 3.6, health assessors should complete additional TEQ calculations when working with data sets containing non-detect (U-qualified) or R-qualified values. This appendix presents sensitivity analyses using the same data set from Appendix B for different approaches to both scenarios. Health assessors who are using the KMcalc Excel macro to calculate TEQs for the first time are encouraged to replicate this example before using the macro for site-specific scenarios. The remainder of this appendix follows the process outlined in Section 3.6. All figures are screen shots from Excel.

1. Sensitivity Analyses for Different Approaches to Handling Non-Detects:

   Health assessors should compare estimated TEQs using two substitution methods:

   - Substituting non-detect congeners with a detected value set to zero.
   - Substituting non-detect congeners with a detected value set to the full detection limit.

   Health assessors can calculate these additional TEQs with the KMcalc macro function by substituting non-detect results and removing all qualifiers (as shown in the image below).



	A	B	C	D	F	G	H
1				Data Sets for Sensitivity Analyses			
2	Measured Dioxin/Furan Congener	TEF (unitless)	Original Data Set (ng/kg)	Substitute 0 for non-detects	Substitute full DL for non-detects	Qualifiers	
3	1,2,3,4,6,7,8-HpCDD	0.01	25	25	25		
4	1,2,3,4,6,7,8-HpCDF	0.01	1.8	1.8	1.8		
5	1,2,3,4,7,8,9-HpCDF	0.01	<0.56	0	0.56		
6	1,2,3,4,7,8-HxCDD	0.1	0.26	0.26	0.26		
7	1,2,3,4,7,8-HxCDF	0.1	<0.6	0	0.6		
8	1,2,3,6,7,8-HxCDD	0.1	2.1	2.1	2.1		
9	1,2,3,6,7,8-HxCDF	0.1	0.33	0.33	0.33		
10	1,2,3,7,8,9-HxCDD	0.1	0.77	0.77	0.77		
11	1,2,3,7,8,9-HxCDF	0.1	0.37	0.37	0.37		
12	1,2,3,7,8-PeCDD	1	0.18	0.18	0.18		
13	1,2,3,7,8-PeCDF	0.03	0.24	0.24	0.24		
14	2,3,4,6,7,8-HxCDF	0.1	<0.14	0	0.14		
15	2,3,4,7,8-PeCDF	0.3	<0.8	0	0.8		
16	2,3,7,8-TCDD	1	1.7	1.7	1.7		
17	2,3,7,8-TCDF	0.1	5.1	5.1	5.1		
18	OCDD	0.0003	220	220	220		
19	OCDF	0.0003	44	44	44		
21			sum:	3.13	3.45		
22			qualifiers:				

For this example, the following TEQs are estimating with the different approaches to handle non-detects. None of the TEQs are J- or U-qualified.

Approach to Handling Non-Detect Observations	TEQ (ng-TEQ/kg)
Initial TEQ based on the KM method	3.21
Lower Bound TEQ substituting zero for non-detects	3.13
Upper Bound TEQ substituting full detection limit for non-detects	3.45

After calculating TEQs with the various methods for handling non-detects, health assessors are instructed to compare the highest estimated TEQ to the lowest estimated TEQ by calculating the relative percent difference (RPD) between the two values. For this example, the highest TEQ was estimated at 3.45 ng-TEQ/kg (while substituting the full DL for non-detects) and the lowest TEQ was estimated at 3.13 ng-TEQ/kg (while substituting zero for all non-detects). The RPD between 3.45 ng-TEQ/kg and 3.13 ng-TEQ/kg is calculated as shown below.

$$\text{RPD} = \left(\frac{|Value_1 - Value_2|}{(Value_1 + Value_2) \div 2)}\right) \times 100$$

$$\text{RPD} = \left(\frac{|3.45 - 3.13|}{(3.45 + 3.13) \div 2)}\right) \times 100$$

$$\text{RPD} = 9.7 \text{ percent}$$

For this example, the RPD between the highest and lowest calculated TEQ is 9.7 percent. This value is below an RPD of 50 percent and therefore suggests that the TEQ is not particularly sensitive to how the non-detects are handled. No further evaluation is necessary and the health assessor should use the initial TEQ based on the KM method.

Health assessors who are calculating TEQs following "Option 1" (described above in Appendix B.1) will be provided with the results of this sensitivity test in the orange-shaded cells of the "OPTION 1 – Calculations" spreadsheet, along with the TEQ result, units, and qualifier outputs.

2. Sensitivity Analyses for Different Approaches to Handling R-qualified results

As described in Section 2, R-qualified results should not be included in TEQs. However, if health assessors excluded any R-qualified results from TEQ calculations, the initial TEQ estimate should be compared to that while including the R-qualified data. There were no R-qualified results in the example shown in Appendix B. However, for illustrative purposes, this section presents the sensitivity analysis for the Appendix B data set, except the detected result for OCDD (220 ng/kg) is assumed to be rejected. TEQ estimates excluding and including the R-qualified result (200 ng/kg for OCDD) are shown in the table below.

Approach to Handling R-Qualified Results	Estimated TEQ (ng/kg)
Initial TEQ based on the KM method excluding R-qualified result	3.13
TEQ based on the KM method including R-qualified result	3.21

The RPD between the initial TEQ and the TEQ included R-qualified results is 2.9 percent, suggesting that the exclusion of rejected data has minimal impact on the overall TEQ. In this case, health assessors would proceed with the initial TEQ.

EXHIBIT 9

IN THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF OHIO
EASTERN DIVISION

IN RE: EAST PALESTINE TRAIN DERAILMENT	)	CASE NO. 4:23-cv-00242-BYP
	)	JUDGE BENITA Y. PEARSON

PROTECTIVE ORDER

It is ORDERED:

1. **Scope.** All documents produced in the course of discovery, including initial disclosures, all responses to discovery requests, all deposition testimony and exhibits, other materials which may be subject to restrictions on disclosure for good cause and information derived directly therefrom) (hereinafter collectively "documents"), shall be subject to this Order concerning confidential information as set forth below. As there is a presumption in favor of open and public judicial proceedings in the federal courts, this Order shall be strictly construed in favor of public disclosure and open proceedings wherever possible. The Order is also subject to the Local Rules of this District and the Federal Rules of Civil Procedure on matters of procedure and calculation of time periods.

2. **Form and Timing of Designation.** A party may designate documents as confidential and restricted in disclosure under this Order by placing or affixing the words "CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER" or "CONFIDENTIAL

ATTORNEYS' EYES ONLY" on the document in a manner that will not interfere with the legibility of the document and that will permit complete removal of the CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY designation. Documents shall be designated CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY prior to or at the time of the production or disclosure of the documents. When electronically stored information is produced which cannot itself be marked with the designation CONFIDENTIAL or CONFIDENTIAL ATTORNEYS' EYES ONLY, the physical media on which such electronically stored information is produced shall be marked with the applicable designation. The party receiving such electronically stored information shall then be responsible for labeling any copies that it creates thereof, whether electronic or paper, with the applicable designation. By written stipulation the parties may agree temporarily to designate original documents that are produced for inspection CONFIDENTIAL or CONFIDENTIAL ATTORNEYS' EYES ONLY, even though the original documents being produced have not themselves been so labeled. All information learned in the course of such an inspection shall be protected in accordance with the stipulated designation. The copies of documents that are selected for copying during such an inspection shall be marked CONFIDENTIAL or CONFIDENTIAL ATTORNEYS' EYES ONLY, as required under this Order and thereafter the copies shall be subject to protection under this Order in accordance with their designation. The designation "CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER" or "CONFIDENTIAL ATTORNEYS' EYES ONLY" does not mean that the document has any status or protection by statute or otherwise except to the extent and for the purposes of this Order.

3. **Documents Which May be Designated CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER.** Any party may designate documents as CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER upon making a good faith determination that the documents contain information protected from disclosure by statute or that should be protected from disclosure as confidential personal information, medical or psychiatric information, trade secrets, personnel records, or such other sensitive commercial information that is not publicly available. Public records and other information or documents that are publicly available may not be designated as CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER.

4. **Documents Which May be Designated CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER**. Any party may designate documents as CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER upon making a good faith determination that the documents contain highly sensitive trade secrets or other highly sensitive competitive or confidential information and disclosure to another party would result in demonstrable harm to the disclosing party.

5. **Depositions.** Deposition testimony shall be deemed CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY only if designated as such. Such designation shall be specific as to the portions of the transcript or any exhibit to be designated as CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY. Such designations may be made either (a) at the time the testimony is given, or (b) within thirty (30) business days following receipt of a transcript by written notice to the court reporter, with a copy of the notice to counsel for each Party to the Action of the specific pages and lines of the transcript that contain material that is

CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY. All deposition transcripts shall be treated as CONFIDENTIAL in their entirety until thirty (30) business days following receipt of the transcript unless receipt of confidentiality designations is received earlier. After designation, the deposition transcripts and any of those portions so designated shall be protected as CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY, pending the resolution of any objection, under the terms of this Order.

6. **Protection of Confidential and Confidential Attorneys' Eyes Only Material.**

(a) **General Protections.** Documents designated CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER and CONFIDENTIAL ATTORNEYS' EYES ONLY under this Order shall not be used or disclosed by the parties, counsel for the parties or any other persons identified in ¶ 6(b) or 6(c), as applicable, for any purpose whatsoever other than to prepare for and to conduct discovery and trial in this action, including any appeal thereof.

(b) **Limited Disclosures for Confidential Documents.** The parties and counsel for the parties shall not disclose or permit the disclosure of any CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER documents to any third person or entity except as set forth in subparagraphs (1)-(6). Subject to these requirements, the following categories of persons may be allowed to review documents that have been designated CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER (all such persons, including parties, shall execute the certification contained in Attachment A, Acknowledgment of Understanding and Agreement to Be Bound):

(1) **Counsel.** Outside counsel for the parties and employees and agents of outside counsel who have responsibility for the preparation and trial of the action;

(2) **Parties.** Parties and employees of a party to this Order who are directly and actively involved in assisting with the prosecution or defense of this Action.

(3) **Court, Court Reporters and Recorders.** The Court, court reporters, videographers, stenographers, and court personnel, as are necessarily incident to depositions, hearings, or trial;

(4) **Consultants, Investigators and Experts.** Consultants, investigators, or experts (hereinafter referred to collectively as "experts") employed by the parties or counsel for the parties to assist in the preparation and trial of this action or proceeding, but only after such persons have completed the certification contained in Attachment A, Acknowledgment of Understanding and Agreement to Be Bound;

(5) **Litigation Support Personnel.** Outside photocopying, graphic production services, eDiscovery service providers, or litigation support services employed by the Parties' counsel to assist in this Action, and computer service personnel performing duties in relation to a computerized litigation system;

(6) **Others by Consent.** Other persons only by written consent of the producing party or upon order of the Court and on such conditions as

may be agreed or ordered.

(c) **Limited Disclosures for Confidential Attorneys' Eyes Only Documents.** The parties and counsel for the parties shall not disclose or permit the disclosure of any CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER documents to any person or entity except those set forth in sections 6(b)(1) and 6(b)(3)-(5), above.

(d) **Control of Documents.** Counsel for the parties shall take reasonable and appropriate measures to prevent unauthorized disclosure of documents designated as CONFIDENTIAL and CONFIDENTIAL ATTORNEYS' EYES ONLY pursuant to the terms of this Order. Counsel shall maintain the originals of the forms signed by persons acknowledging their obligations under this Order for a period of 1 year after dismissal of the action, the entry of final judgment and/or the conclusion of any appeals arising therefrom.

(e) **Security**. Any person in possession of "CONFIDENTIAL" or "CONFIDENTIAL ATTORNEYS' EYES ONLY" information shall maintain a written information security program that includes reasonable administrative, technical, and physical safeguards designed to protect the security and confidentiality of such information, protect against any reasonably anticipated threats or hazards to the security of such information, and protect against unauthorized access to such information. To the extent a party or person does not have an information security program, they may comply with this provision by having the "CONFIDENTIAL" or "CONFIDENTIAL ATTORNEYS' EYES ONLY" managed by and/or stored with eDiscovery vendors or

claims administrators that maintain such an information security program. If a receiving party or authorized recipient discovers any loss of "CONFIDENTIAL" or "CONFIDENTIAL ATTORNEYS' EYES ONLY" information or a breach of security, including any potential or suspected unauthorized access, relating to another party's confidential information, the receiving party or authorized recipient shall: (1) immediately provide written notice to the producing or designating Party of such breach; (2) investigate and make reasonable efforts to remediate the effects of the breach, and provide the producing or designating party with assurances reasonably satisfactory to the producing or designating party that such breach shall not recur; and (3) provide sufficient information about the breach that the producing or designating party can reasonably ascertain the size and scope of the breach. The receiving party or authorized recipient shall cooperate with the producing or designating party or law enforcement in investigating any such security incident. In any event, the receiving party or authorized recipient shall promptly take all necessary and appropriate corrective action to terminate the unauthorized access.

(f) **Copies.** Prior to production to another party, all copies, electronic images, duplicates, extracts, summaries or descriptions (hereinafter referred to collectively as "copies") of documents designated as CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY under this Order, or any individual portion of such a document, shall be affixed with the designation "CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER" or "CONFIDENTIAL ATTORNEYS' EYES ONLY" if such legend does not already appear on the copy. With respect to electronic copies of documents produced in native format, this requirement may

be satisfied by including "CONFIDENTIAL" or "CONFIDENTIAL ATTORNEYS' EYES ONLY" in the file name of the documents. All such copies shall thereafter be entitled to the protection of this Order. The term "copies" shall not include indices, electronic databases or lists of documents provided these indices, electronic databases or lists do not contain substantial portions or images of the text of confidential documents or otherwise disclose the substance of the confidential information contained in those documents.

(g) **Inadvertent Production.** Inadvertent production of any document or information without a designation of "CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER" or "CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER" shall be governed consistent with how inadvertently produced privileged documents are treated in the Stipulation and Order Regarding Inadvertent Disclosure of Privileged or Protected Information entered by the Court on June 30, 2023.

7. **Filing of CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER and CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER Documents Under Seal.** Filings may only be sealed by Order of the Court. This Protective Order will not constitute blanket authority to file entire documents under seal. Only confidential portions of relevant documents are subject to sealing. In the event a party seeks to file with the Court any CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER material subject to protection under this Order, unless otherwise ordered by the Court, that party must take appropriate action to ensure that the document receives proper protection from public disclosure. This Order authorizes a party filing a document containing CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER or

CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER

material utilizing the following procedure.

(a) The party filing the motion, opposition, or any other filing containing CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER material ~~is authorized by this Order to~~ shall not file such document ~~provisionally~~ under seal until authorized to do so by an explicit Order of the Court. All filings made under seal shall be submitted electronically and shall be linked to the Order of the Court authorizing the sealing ~~this Stipulated Protective Order~~. B.Y.P.

(b) This Order authorizes persons set forth in Sections 6(b)(1)-(6), above, to have access to CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER documents filed ~~provisionally~~ under seal. This Order authorizes persons set forth in Sections 6(b)(1) and 6(b)(3)-(5), above, to have access to CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER documents filed ~~provisionally~~ under seal. B.Y.P.

(c) ~~Within fourteen days after~~ Prior to the filing of a document ~~provisionally~~ under seal, the party who has previously designated as CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER material ~~referred to in (or attached as an exhibit to) the document~~ may file a motion to seal. It shall be the designating party's burden to demonstrate to the Court that such material should ~~remain~~ be filed under seal. ~~Only confidential portions of relevant documents are subject to sealing, and the party requesting sealing shall simultaneously provide the Court with a proposed redacted version of the document provisionally filed under seal. If no motion to seal is filed within fourteen days after the~~ B.Y.P.

~~filing of a document filed provisionally under seal, the document shall be made public.~~

(d) Within five days after the filing of a motion to seal ~~and proposed redactions~~, any other party may file a response to such motion ~~and/or propose alternative redactions~~. Replies to such responses are not permitted. B.Y.P.

(e) The parties may submit an agreed proposed redacted version of any document filed ~~provisionally~~ under seal for the Court's consideration. *See* Electronic Filing Policies and Procedures Manual at Sections 19 and 24. B.Y.P.

~~(f) If the Court denies the motion to seal, the document shall be made public with no redactions. If the Court grants the motion to seal in whole or in part, the moving party shall file a redacted version of the document that complies with the Court's order within three days after the Court's ruling.~~ B.Y.P.

Unless otherwise ordered by the Court, all documents that may have been subject to sealing during discovery or motion practice will not necessarily enjoy a protected or confidential designation if the matter comes on for hearing, argument, or trial on the merits in the courtroom. The hearing, argument, or trial on the merits will be public in all respects, except to the extent otherwise ordered by the Court.

8. **Challenges by a Party to Designation as Confidential.** Any CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER designation is subject to challenge by any party or non-objecting party with standing to object (hereafter "party"). Before filing any motions or objections to a confidentiality designation with the Court, the objecting party shall have an obligation to meet and confer in a good faith effort to resolve the objection by agreement. If agreement is reached confirming or waiving the CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER or B.Y.P.

CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER designation as to any documents subject to the objection, the designating party shall serve on all parties a notice specifying the documents and the nature of the agreement.

9. **Action by the Court.** Applications to the Court for an order relating to any documents designated CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER shall be by motion under Local Rule 7.1 and any other procedures set forth in the presiding judge's standing orders or other relevant orders. Nothing in this Order or any action or agreement of a party under this Order limits the Court's power to make any orders that may be appropriate with respect to the use and disclosure of any documents produced or ~~use~~ used in discovery or at trial. B.Y.P.

10. **Use of Confidential Documents or Information at Trial.** All trials are open to the public. Absent order of the Court, there will be no restrictions on the use of any document that may be introduced by any party during the trial. Unless otherwise ordered by the Court, if a party intends to present at trial CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER documents or information derived therefrom, such party shall provide advance notice to the other party at least five (5) days before the commencement of trial by identifying the documents or information at issue as specifically as possible (i.e., by Bates number, page range, deposition transcript lines, etc.) without divulging the actual CONFIDENTIAL – SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER documents or information. The Court may thereafter make such orders as are necessary to govern the use of such documents or information at trial.

11. **Obligations on Conclusion of Litigation.**

(a) **Order Remains in Effect.** Unless otherwise agreed or ordered, this Order shall remain in force after dismissal or entry of final judgment not subjectto further appeal.

(b) **Return of CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER and CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER Documents.** Within thirty days after dismissal or entry of final judgment not subject to further appeal, all documents treated as CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER and CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER under this Order, including copies as defined in ¶ 6(e), shall be returned to the producing party unless: (1) the document has been offered into evidence or filed without restriction as to disclosure; (2) the parties agree to destruction in lieu of return; or (3) as to documents bearing the notations, summations, or other mental impressions of the receiving party, that party elects to destroy the documents and certifies to the producing party that it has done so. Notwithstanding the above requirements to return or destroy documents, counsel may retain attorney work product, including an index which refers or relates to information designated CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER and CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER, so long as that work product does not duplicate verbatim substantial portions of the text or images of confidential documents. This work product shall continue to be CONFIDENTIAL -

f B.Y.P.

SUBJECT TO PROTECTIVE ORDER and CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER under this Order. An attorney may use his or her work product in a subsequent litigation provided that its use does not disclose or use CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER and CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER documents.

(c) **Return of Documents Filed under Seal.** After dismissal or entry of final judgment not subject to further appeal, the Clerk may elect to return to counsel for the parties or, after notice, destroy documents filed or offered at trial under seal or otherwise restricted by the Court as todisclosure.

12. **Order Subject to Modification.** This Order shall be subject to modification by the Court on its own motion or on motion of a party or any other person with standing concerning the subject matter. Motions to modify this Order shall be served and filed under Local Rule 7.1 and the presiding judge's standing orders or other relevant orders.

13. **No Prior Judicial Determination.** This Order is entered based on the representations and agreements of the parties and for the purpose of facilitating discovery. Nothing herein shall be construed or presented as a judicial determination that any documents or information designated CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER by counsel or the parties is subject to protection under Rule 26(c) of the Federal Rules of Civil Procedure or otherwise until such time as the Court may rule on a specific document or issue.

14. **Persons Bound.** ~~This Order shall take effect when entered and~~ The parties are bound by the terms prior and subsequent to entry of this Order; and it shall be binding B.Y.P.

upon all counsel and their law firms, the parties, and persons made subject to this Order by its terms.

15. **Rendering Advice to Clients.** Nothing in this Order is intended to bar or otherwise prevent counsel from rendering advice to their respective clients with respect to this action, and in the course of rendering such advice, from relying upon their examination or knowledge of materials designated as CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER.

AGREED AS TO FORM

Dated: July 31, 2023

Respectfully submitted,

/s/ Seth A. Katz

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Counsel for Defendants
Norfolk Southern Corporation and Norfolk Southern Railway Company

IT IS SO ORDERED.

August 2, 2023
Date

/s/ Benita Y. Pearson
The Honorable Benita Y. Pearson
United States District Judge

FORM PROTECTIVE ORDER
ATTACHMENT A

IN THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF OHIO
EASTERN DIVISION

IN RE: EAST PALESTINE TRAIN DERAILMENT	)	CASE NO. 4:23-cv-00242-BYP
	)	
	)	
	)	
	)	JUDGE BENITA Y. PEARSON
	)	
	)	
	)	

ACKNOWLEDGMENT AND AGREEMENT TO BE BOUND

The undersigned hereby acknowledges that he/she has read the Protective Order dated August 2, 2023 in the above-captioned action and attached hereto, understands the terms thereof, and agrees to be bound by its terms. The undersigned submits to the jurisdiction of the United States District Court for the Northern District of Ohio in matters relating to the Protective Order and understands that the terms of the Protective Order obligate him/her to use documents designated CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER or CONFIDENTIAL ATTORNEYS' EYES ONLY – SUBJECT TO PROTECTIVE ORDER in accordance with the Order solely for the purposes of the above-captioned action, and not to disclose any such documents or information derived directly therefrom to any other person, firm, or concern.

The undersigned acknowledges that violation of the Protective Order may result in penalties for contempt of court.

Name: _____

Job Title: _____

Employer: _____

Business Address: _____

_____

_____

Date:_____ _____

Signature

EXHIBIT 10

SHERROD BROWN
OHIO

COMMITTEES:
AGRICULTURE, NUTRITION, AND FORESTRY
BANKING, HOUSING, AND URBAN AFFAIRS
FINANCE
VETERANS' AFFAIRS

United States Senate
WASHINGTON, DC 20510 - 3505

August 7, 2023

President Joseph Biden
The White House
1600 Pennsylvania Avenue NW
Washington, DC 20500

Administrator Deanne Criswell
Federal Emergency Management Agency
500 C Street SW
Washington, DC 20024

Dear President Biden and Administrator Criswell:

It has been six months since the derailment of a Norfolk Southern train devastated the East Palestine, Ohio community. While I appreciate all that the federal government, including the Federal Emergency Management Agency (FEMA), has done to support recovery efforts in East Palestine, more assistance is necessary to ensure the community and its residents have the support necessary to address the ongoing challenges caused by the derailment. In line with previous assistance, I urge you to approve Governor DeWine's Major Disaster Declaration request per the Stafford Act (42 USC 5170) to unlock additional resources from the federal government that can help address the ongoing needs in East Palestine.

The train derailment was a catastrophic disaster that has had a large environmental impact on the community, imposing a massive toll on the physical, emotional, and financial health of the entire region, which continues to impact residents six months after the accident. The derailed cars spilled toxic chemicals including vinyl chloride, butyl acrylate, 2-ethylhexyl acrylate, and ethylene glycol monobutyl ether. The runoff from the toxic spill and fire remnants has contaminated soil and flowed into downstream waterbodies. Dozens of families are still displaced from their homes, and the long-term effects on residents of the hazardous chemical release are still not known. A disaster of this scale, scope, and significance necessitates a response and deployment of resources that are commensurate in scale and scope. These residents need federal resources to help them get back on their feet, and any delay of these resources will have a direct, negative impact on the recovery efforts.

Since the derailment, I – and the other members of the Ohio congressional delegation – have made it a top priority to support the people of East Palestine, advance the cleanup effort, and address the railway companies' profit-focused lax safety. In the immediate aftermath of this tragic derailment, I urged state and federal officials to act promptly so that FEMA could provide all possible assistance to the community, and I urged FEMA to visit East Palestine and witness

firsthand the devastation that had occurred. I appreciated that you sent Regional Administrator Sivak and an Incident Management Assistance Team to Ohio. Despite ongoing efforts from FEMA, the Department of Health and Human Services (HHS) and its Centers for Disease Control and Prevention (CDC), the Environmental Protection Agency (EPA), and other federal agencies, residents of East Palestine and the surrounding area are still living with the consequences of the derailment daily.

In a meeting I had just two weeks ago with residents from East Palestine, representatives from the community shared some of the challenges they continue to face as a result of this devastating derailment – some are still forced to live away from home, others are concerned about the quality of the air in their homes or the impact of basement groundwater exposure, and many are facing a range of health symptoms and are understandably concerned about their health both now and in the future. Nobody trusts Norfolk Southern to do what's right by the community and compensate residents for the significant costs – including health care costs – that have resulted from the company's negligence. Understandably, this community feels left behind – by both the company and their government.

Additional FEMA assistance – through programs and resources such as the Individuals and Households Program, the Crisis Counseling Program, the Disaster Unemployment Assistance program, Disaster Legal Services, and Small Business Administration Disaster Assistance – is critical to helping the residents return to living their lives. While Norfolk Southern must ultimately be held responsible for paying for the entirety of the recovery efforts, Ohioans should not be forced to wait around on this company that has proven it can't be trusted. East Palestine needs federal resources now, while the government figures out the best way to recover these funds from Norfolk Southern.

On July 3, 2023, Governor DeWine sent a letter requesting a Major Disaster Declaration per the Stafford Act (42 USC 5170) to aid on East Palestine's recovery. I was heartened to see the Governor make this request; however, the Governor has yet to receive formal response from FEMA. Residents of East Palestine shouldn't have to wait any longer for additional assistance. If additional information is required, I ask that you clearly outline what steps Governor DeWine, the Ohio Emergency Management Agency, and the Ohio Environmental Protection Agency must take to facilitate approval of the Governor's July request and unlock additional resources from the federal government. Further delay is unacceptable.

In addition to working with the state of Ohio to ensure this request for additional federal aid is approved in a timely manner, I also ask that the Administration provide a detailed list of all the actions taken and funding provided by the federal government in response to the Norfolk Southern derailment. The people of East Palestine deserve to know what their federal government is doing to fight for them and hold Norfolk Southern accountable. I would further ask that you detail what additional steps the federal government can take to assist those still suffering from the derailment – with or without a disaster declaration.

The people of this community had their lives overturned by 53 train cars and the negligence of a corporation that cut safety to enrich its bottom line. These Ohioans and their neighbors in Pennsylvania have experienced trauma that no American should ever have to experience. It's our responsibility to do everything possible to help them recover. I will continue to do all in my power to support the families and small businesses of East Palestine.

Now it is your time to step up and provide the support that only FEMA can. If additional information is needed from the State of Ohio to approve the Governor's request, I ask that you identify any deficiencies and work with the state of Ohio to ensure community gets all the aid that it is eligible for in a timely manner. We need to show the people of East Palestine that their government continues to do everything in its power to help them recover.

Sincerely.

Sherrod Brown
United States Senator

CC: U.S. Environmental Protection Administrator Regan

EXHIBIT 11

BILL JOHNSON
6TH DISTRICT, OHIO

COMMITTEE ON ENERGY AND COMMERCE

CHAIRMAN
SUBCOMMITTEE ON ENVIRONMENT, MANUFACTURING, AND CRITICAL MINERALS

SUBCOMMITTEE ON ENERGY, CLIMATE AND GRID SECURITY

SUBCOMMITTEE ON HEALTH

CONGRESS OF THE UNITED STATES
HOUSE OF REPRESENTATIVES

WASHINGTON OFFICE
2082 Rayburn House Office Building
Washington, DC 20515
(202) 225-5705

August 18, 2023

[redacted]
East Liverpool, OH 43920

Dear [redacted]

Thank you for contacting me about the devastating train derailment in East Palestine, and thank you for your patience as my team and I work to find answers to your questions. I have passed your concerns along to the appropriate federal agency, and I am continuing to work closely with them until everyone in East Palestine feels safe and secure…and that includes getting answers to your and other residents' questions.

I have visited East Palestine multiple times each month since the derailment and will continue to do so. It has been extremely heartbreaking to hear the stories of those affected firsthand by this tragic accident. I have taken your and many other residents' stories back to Washington with me, where I continue fighting for answers to all questions as well as working to prevent this from happening again.

Immediately following the derailment, I introduced H.R. 1270, the East Palestine Tax Relief Act, to ensure that recipients of disaster relief payments are exempt from paying taxes on those funds. I also introduced H.R. 1633, the RAIL Act, which enhances safety requirements for trains transporting hazardous materials. It has been encouraging to see my colleagues come together to support the people of East Palestine, as both bills have accumulated cosponsors from both sides of the political aisle.

While these are important steps, my work on this matter is far from over. This January, I was selected to chair the Energy and Commerce Subcommittee on Environment, Manufacturing, and Critical Minerals — my first hearing as Chairman was on the government's response to the derailment in East Palestine. This gave me the opportunity to ask questions on behalf of my constituents to key witnesses including EPA Regional Administrator Debra Shore, Ohio EPA Director Anne Vogel, and Columbiana County Health Commissioner Wesley Vins. It was a productive first hearing, and there will be more hearings held on East Palestine in the future.

I have called on President Biden to visit the Village of East Palestine many times, though he has yet to do so. On July 5, 2023, Governor DeWine requested that President Biden issue a Major Presidential Disaster Declaration relating to the Norfolk Southern train derailment. I support Governor's DeWine's request.

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Marietta, OH 45750
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BillJohnson.house.gov

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Suite 106
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(330) 967-7312

BILL JOHNSON
6TH DISTRICT, OHIO

COMMITTEE ON ENERGY AND COMMERCE

CHAIRMAN
SUBCOMMITTEE ON
ENVIRONMENT,
MANUFACTURING,
AND CRITICAL MINERALS

SUBCOMMITTEE ON ENERGY,
CLIMATE
AND GRID SECURITY

SUBCOMMITTEE ON HEALTH

CONGRESS OF THE UNITED STATES
HOUSE OF REPRESENTATIVES

WASHINGTON OFFICE
2082 Rayburn House Office Building
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(202) 225-5705

I am committed to the village and residents of East Palestine and will continue to hold all involved parties accountable, including Norfolk Southern. On February 14th, I sent a letter to Norfolk Southern CEO Alan Shaw asking him to expand the reimbursement and assistance area, which was successfully expanded 2 days later to include the entire 44413 zip code. Norfolk Southern is well aware that I am holding them under a microscope and I will continue to do so.

Many resources have become available to residents since the derailment, and my office is happy to assist in connecting you with authorities that can answer your questions. There is also a list of resources on my website. In the meantime, my office will provide you responses to your questions as we hear back from the relevant federal agency.

Sincerely,

Bill Johnson

Bill Johnson
Member of Congress

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EXHIBIT 12

Committees:

Armed Services and Veterans Affairs
House Health Provider Services
Joint Medicaid Oversight Committee
State and Local Government
Technology and Innovation

Contact Information:

Office: 614-466-8550
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77 S. High Street, 13th Floor
Columbus, Ohio 43215-6111

Representative Jennifer Gross
The Ohio House of Representatives

08/29/2023

President Joseph R. Biden
The White House
1600 Pennsylvania Avenue, N.W.
Washington, DC 20500

To President Biden,

As a State Representative in Ohio, I am writing to you today to voice my strong and unwavering support for the citizens of East Palestine, Ohio. This town has suffered greatly since the train derailment on February 3rd of this year: thousands of lives were upended, the environment was polluted with hundreds of tons of toxins, and many uncertainties remain today. It is crucial that more is done to help these citizens get back to their normal lives, they should not be abandoned nor forgotten any longer. My question for you is, what are you doing to help them?

The Unity Council for the East Palestine Train Derailment traveled to Washington DC at the end of July. The council's mission was to implore our government to support the community impacted by the train derailment; there are still unmet needs that are not okay. Several elected officials met with the council from around the nation, speaking to the issue at hand being an issue everyone can get behind to support our fellow Americans. Mr. President, I am pleading for you to actually hear the cries for help. As someone who has visited the area and seen the impact firsthand, I ask that you make good on your promise to visit East Palestine.

Mr. President, I also request you to fulfill your promise to provide what is needed to help. This is not a red issue or a blue issue, this is an issue of human lives being severely impacted for no wrongdoing of their own. This could happen to any community, and this time it happens to be in Ohio. Weeks ago, Gov. Mike DeWine requested a Major Disaster Declaration to guarantee the delivery of resources the community needs to save itself. Still after six months of recovering from the disaster, the removal of contaminants remains an ongoing project and thousands of tons of chemical soil are in East Palestine. Simultaneously, monitoring of the long-term health impacts of the chemical spill should be a priority of yours: if health is normal or if they feel sick, a citizen should know they are getting the truth and that access to treatment is readily available.

There has been progress made since February, but so much more needs to be done. Legislation is progressing nationally and Norfolk Southern is recouping losses within the community, but it is not enough at this point in time. These citizens cannot afford to take on the entire burden of rebuilding this area from disaster on their own. President Biden, please do not forget East

Palestine any longer. Now is the time to do what is right before it is too late. A Major Disaster Declaration, full removal of contaminated soil, and improved monitoring of long-term health impacts are crucial to East Palestine surviving this crisis.

Thank you for your urgent consideration of this matter. You may reach out to me or my staff at any time. We are more than happy to do what is necessary to coordinate a lasting solution.

Respectfully,

Jennifer Gross

State Representative

45th Ohio House District

EXHIBIT 13

JAMES COMER, KENTUCKY
CHAIRMAN

ONE HUNDRED EIGHTEENTH CONGRESS

JAMIE RASKIN, MARYLAND
RANKING MINORITY MEMBER

Congress of the United States

House of Representatives

COMMITTEE ON OVERSIGHT AND ACCOUNTABILITY

2157 RAYBURN HOUSE OFFICE BUILDING

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MINORITY (202) 225–5051

https://oversight.house.gov

September 5, 2023

The Honorable Pete Buttigieg
Secretary
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

Dear Secretary Buttigieg:

The Committee on Oversight and Accountability is conducting oversight of the Department of Transportation ("the Department") following a series of aviation and rail safety failures. These failures indicate a recent and disturbing pattern of failures at the Department placing at the safety of Americans at risk. Therefore, we request a briefing, documents, and communications related to the Department's efforts to investigate and remediate these issues to protect the safety of all Americans.

In the Department of Transportation's Office of the Inspector General (OIG) Report on the Fiscal Year 2023 Top Management Challenges, the OIG found that "Aviation Safety" and "Surface Transportation Safety" are again the leading management challenges and have been so since at least 2021.[1] Specifically, the OIG notes a need to "address long unresolved [aviation] safety issues."[2] The OIG also highlighted the need to "overcome[e] oversight challenges to help reduce surface transportation fatalities," and improve surface transportation infrastructure.[3] Despite the OIG's consistent warnings, it appears that the Department has not addressed these concerns. Federal Aviation Administration (FAA) data indicate that there were 1,730 runway incursions in all of 2022 while there have already been 1,539 this year as of July 24, 2023.[4] Further, reports suggest that "if the pattern of near misses involving airlines at U.S. airports continues to increase, it will surpass any annual total of these types of incidents in over two decades, per a public FAA database."[5] In the past year, a series of passenger safety incidents occurring at airports across the country indicate these problems continue to persist:

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[1] U.S. DEPT. OF TRANSPORTATION, OFFICE OF INSPECTOR GENERAL, DOT'S TOP MANAGEMENT CHALLENGES FISCAL YEAR 2023 (2022).
[2] *Id.*
[3] *Id.*
[4] Federal Aviation Admin., *Runway Incursion Totals by Quarter FY2023 vs. FY2022*, FEDERAL AVIATION ADMIN. (Last accessed September 1, 2023). Available at https://www.faa.gov/airports/runway_safety/statistics/year/?fy1=2023&fy2=2022
[5] Theara Coleman, *The Strange Rise of Airplane Near Collisions in the U.S.*, THE WEEK (June 7, 2023).

1. September 21, 2022: Departing passenger plane sparks and sheds debris at takeoff forcing an emergency landing at Newark Liberty International Airport.[6]

2. December 18, 2022: Departing passenger plane plunges within 800 feet of the Pacific Ocean after taking off from Kahului Airport in Maui, Hawaii.[7]

3. December 31, 2022: Ground crew ramp agent was killed in an incident involving a plane engine at Montgomery Regional Airport in Alabama.[8]

4. January 13, 2023: Departing passenger plane nearly collides with another passenger plane during takeoff at John F. Kennedy International Airport.[9]

5. February 3, 2023: Taxiing passenger plane collides with another passenger plane parked at Newark Liberty International Airport damaging the winglet of the parked aircraft.[10]

6. February 4, 2023: Landing cargo plane nearly collides with a passenger flight cleared to depart on the same runway at Austin-Bergstrom International Airport.[11]

7. February 22, 2023: Landing passenger plane was forced to abort landing after nearly colliding with another passenger plane cleared for the same runway at Hollywood Burbank Airport.[12]

8. February 27, 2023: Landing commercial plane nearly collides with a smaller passenger plane at Boston Logan International Airport.[13]

9. March 7, 2023: Passenger plane crossed a runway without clearance at Ronald Reagan Washington National Airport nearly colliding with another passenger plane that had just been cleared for takeoff.[14]

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[6] Gregory Wallace and Pete Muntean, *A United Airlines flight made an emergency landing at New Jersey's Newark airport after circling over the Atlantic*, CNN (September 22, 2022).
[7] Marlene Lenthang, *United Airlines plane taking off from Maui plunged to within 800 feet of the Pacific Ocean, flight data shows*, NBC NEWS (February 13, 2023).
[8] Greg Norman, *Alabama airline worker sucked into engine with 'bang,' plane filled with passengers shook violently: NTSB*, FOX BUSINESS (January 24, 2023).
[9] Katherine Donlevy, *Plane on takeoff nearly collides with another at JFK Airport*, NEW YORK POST (January 15, 2023).
[10] Taylor Rains, *Two United aircraft collided at Newark Liberty Airport and now the FAA is investigating*, BUSINESS INSIDER (February 3, 2023).
[11] Christine Chung, *Planes Narrowly Avoid Collision on Austin Airport Runway*, THE NEW YORK TIMES (February 5, 2023).
[12] Faris Tanyos, *Runway scare forces passenger jet to abort landing at Burbank Airport; FAA investigating*, CBS NEWS (February 24, 2023).
[13] Jordan Mendoza, *JetBlue flight, Learjet involved in 'close call' at Boston Logan Airport; FAA investigating*, USA TODAY (February 28, 2023.).
[14] Chris Pandolfo, *FAA Investigates Another Close Call, This Time at Reagan National Airport, Ahead of Safety Summit*, FOX BUSINESS (March 15, 2023).

10. April 13, 2023: Passenger plane clipped the wing of another passenger plane at Miami International Airport.[15]

11. May 19, 2023: Two passenger planes were forced to abort landing at San Francisco International Airport after another passenger plane was spotted taxiing across the runways where they were cleared to land.[16]

12. June 14, 2023: Landing passenger plane was forced to abort landing after another plane was discovered on the same runway at Minneapolis-St. Paul International Airport.[17]

13. June 23, 2023: Ground crew member was killed in an incident involving a plane engine at San Antonio International Airport.[18]

In addition to these aviation incidents, there appears to be a similar pattern of safety failures occurring within our nation's rail sector. Since the beginning of 2021, there have been approximately 2,000 rail incidents reported nationwide, including approximately 1,310 derailments and 146 collisions.[19] Several recent major incidents include:

1. November 1, 2022: Freight train containing hazardous materials derails in Ravenna Township, Ohio where cleanup continues months after the incident.[20]

2. February 3, 2023: Freight train derails in East Palestine, Ohio resulting in the release of thousands of gallons of toxic chemicals into the surrounding area.[21]

3. February 16, 2023: Freight train carrying hazardous materials derails in Van Buren Township outside of Detroit, Michigan.[22]

4. February 21, 2023: Freight train carrying coal derails in Gothenburg, Nebraska.[23]

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[15] NBC 6 Miami, *Planes Clip Wings at Miami International Airport*, NBC NEWS 6 MIAMI (April 13, 2023). Available at, https://www.nbcmiami.com/on-air/as-seen-on/planes-clip-wings-at-miami-international-airport/3014565/

[16] The Associated Press, *2 Planes Aborted Landings in San Francisco when a Southwest Jet Taxied Across their Runways*, ABC NEWS (May 25, 2023).

[17] Emma Bowman, *The FAA is Investigating the Latest Close-Call After Minneapolis Runway Incident*, NAT'L Public Radio (June 18, 2023).

[18] Kamal Sultan, *Airport Worker is Killed After Being 'Ingested' into the Engine of a Delta Flight Taxiing in San Antonio in the Latest Shocking Aviation Incident in the U.S.*, DAILY MAIL.COM (June 24, 2023).

[19] U.S. DEPT. OF TRANSPORTATION, FEDERAL RAILROAD ADMIN., TRAIN ACCIDENTS BY TYPE, (Last accessed August 24, 2023). *Available at* https://railroads.dot.gov/accident-and-incident-reporting/train-accident-reports/train-accidents-type

[20] Eric Marotta, *Norfolk Southern continuing cleanup from Ravenna Township, Sandusky derailments*, AKRON BEACON JOURNAL (February 19, 2023).

[21] *Timeline: The toxic chemical train derailment in Ohio*, CBS NEWS (February 14, 2023).

[22] Greg Norman, *Train derails outside Detroit, Michigan, with one car carrying hazardous materials*, FOX NEWS (February 16, 2023).

[23] Orlando Mayorquin, *In another train derailment, 31 Union Pacific cars carrying coal derail in Nebraska, company says*, USA TODAY (February 22, 2023).

5. February 28, 2023: Propane tanker, carrying 30,000 gallons of fuel, overturns after a freight train derails in Manatee County, Florida.[24]

6. March 30, 2023: Freight train carrying ethanol and corn syrup derailed and caught fire in Raymond, Minnesota prompting hundreds to temporarily evacuate the town.[25]

7. April 15, 2023: Freight train carrying hazardous materials derailed in Rockwood, Maine.[26]

8. May 31, 2023: Freight train carrying hazardous materials detailed in Lancaster, Minnesota.[27]

9. June 24, 2023: Freight train carrying molten sulfur or asphalt derailed and plunged into the Yellowstone River in Montana.[28]

Despite these incidents, the Office of the Secretary of Transportation (OST) has more than 86 new unresolved recommendations since President Biden took office.[29] According to the OIG, a recommendation is "unresolved" if "agency management disagrees with the recommendation or the OIG disagrees with the agency's proposed corrective actions."[30] OMB requires that OIG recommendations be "resolved" within six months.[31] These recommendations include ways to improve "safety, efficiency, and economy" in several DOT programs including aviation and rail safety, which raises serious concerns that had the OST acted on these numerous recommendations, recent failures might have been prevented.[32] It appears from the OIG's catalogue of long overdue and unresolved recommendations that DOT's leadership is not prioritizing Americans' safety on air, land, and sea.

These safety failures have eroded the public's confidence in air and rail safety and necessitates thorough investigation. Therefore, we request the following documents and communications related to the Department's efforts to investigate and remediate these serious

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[24] Chantal Da Silva, *Train carrying propane derails miles away from Florida airport*, NBC NEWS (March 1, 2023).
[25] Josh Funk and Trisha Ahmed, *Minnesota Train Derailment, Ethanol Fire Renew Safety Fears*, THE ASSOCIATED PRESS (March 30, 2023).
[26] Andrew Mark Miller, *Train Carrying Hazardous Materials Derails in Rural Maine*, NEW YORK POST (April 15, 2023).
[27] WCCO Staff, *Train Containing Hazardous Materials Derails Near Minnesota-Canada Border*, CBS NEWS MINNESOTA (May 31, 2023).
[28] Eduardo Medina, *Montana Derailment Sends 10 Freight Cars Into the Yellowstone River*, THE NEW YORK TIMES (June 24, 2023).
[29] *See* "Agency Progress on Recommendations" [under "Recommendation Dashboard Charts"], U.S. DEPARTMENT OF TRANSPORTATION | OFFICE OF INSPECTOR GENERAL. (Last accessed September 1, 2023).
[30] *Supra note* 2.
[31] *Id.*
[32] "Semiannual Report to Congress (April 1, 2022-September 30, 2022)," U.S. DEPARTMENT OF TRANSPORTATION | OFFICE OF INSPECTOR GENERAL, p. 14.

safety issues, covering the time period January 21, 2021 to the present unless otherwise indicated, no later than September 19, 2023:

1. Documentation and data summarizing all aviation and rail events which may have or did result in injury, death, damage, or detrimental financial impact known to the Department;

2. All documents and communications between the Department, the White House, and any other federal agency related to each event listed above or identified in response to request number 1;

3. All internal Department documents and communications related to each event listed above or identified in response to request number 1;

4. Department plans and operating procedures to prevent future aviation and surface transportation safety events;

5. All findings related to each event which may have or did result in injury, death, damage, or detrimental financial impact; and

6. All documents and communications related to resolving open recommendations provided to the Department by the Office of Inspector General.

Additionally, the Committee requests a staff-level briefing as soon as possible, but not later than September 19, 2023.

To schedule the briefing, or to ask any related follow-up questions, please contact the Committee on Oversight and Accountability Majority staff at 202-225-5074. Attached are instructions for producing the documents and information to the Committee. The Committee on Oversight and Accountability is the principal oversight committee of the U.S. House of Representatives and has broad authority to investigate, "any matter" at "any time" under House Rule X. Thank you for your attention to this important matter.

Sincerely,

James Comer
Chairman
Committee on Oversight and Accountability

Glenn Grothman
Chairman
Subcommittee on National Security,
the Border, and Foreign Affairs

Pete Sessions
Chairman
Subcommittee on Government Operations
and the Federal Workforce

Nancy Mace
Chairwoman
Subcommittee on Cybersecurity,
Information Technology, and
Government Innovation

Lisa McClain
Chairwoman
Subcommittee on Health Care and
Financial Services

Jim Jordan
Member of Congress

Michael R. Turner
Member of Congress

Paul A. Gosar, D.D.S.
Member of Congress

Virginia Foxx
Member of Congress

Clay Higgins
Member of Congress

Jake LaTurner
Member of Congress

Byron Donalds
Member of Congress

Kelly Armstrong
Member of Congress

Tim Burchett
Member of Congress

Marjorie Taylor Greene
Member of Congress

Lauren Boebert
Member of Congress

Russell Fry
Member of Congress

Anna Paulina Luna
Member of Congress

Chuck Edwards
Member of Congress

Nick Langworthy
Member of Congress

cc: The Honorable Jamie B. Raskin, Ranking Member
Committee on Oversight and Accountability

EXHIBIT 14

September 21, 2023

Government Accountability Project launches investigation into East Palestine disaster response, files FOIA lawsuit against EPA, provides citizen whistleblower protection for independent scientist Scott Smith

WASHINGTON —Government Accountability Project is launching its own investigation into the EPA's response to the East Palestine train derailment and providing citizen whistleblower protection to Scott Smith, the independent scientist who uncovered significantly elevated levels of dioxins and related compounds, or furans, in East Palestine, Ohio.

Government Accountability Project found Smith's allegations are credible, serious, and deserving of scrutiny, despite thus far being denied by the EPA. In the seven months since the disaster, the independent testing expert and CEO of U.S. BioSolutions, LLC, reports that he has found levels of dioxins and related furans in East Palestine's air, water, soil, and in the homes of its residents that are notably higher than baseline samples common to unaffected communities.

"The EPA has been disingenuous about the facts of contamination while residents in East Palestine have become sicker and sicker. The failure of government is reminiscent of how we treated our military servicemen and women who were exposed to the burn pits of the Gulf War," Smith said. "When multiple chemicals are burned simultaneously, thousands of different chemicals are formed. These dioxins and furans may create an additive and/or synergistic toxicity. The people of East Palestine, especially those with children who are coughing up blood, have every right to question the motives behind the open burning decision and more. Some people are getting sicker and sicker, so something is going on."

As part of its investigation, Government Accountability Project filed a FOIA lawsuit today against the EPA through Chicago firm Loevy & Loevy for denying expedited processing and a fee waiver to Government Accountability Project for its FOIA, which requested data and communications on dioxins and other chemicals spilled and burned during the derailment. In the organization's 46 years, the organization has never been turned down for a fee waiver.

"One essential purpose of the Freedom of Information Act is to let the people know what the federal government is doing on their behalf in a timely manner," said Louis Clark, Government Accountability Project's Executive Director and CEO. "This community is enduring a significant crisis now. It simply does not have the luxury of waiting for years for documentation about what is going on related to the derailment catastrophe within the Environmental Protection Agency."

In its FOIA, Government Accountability Project maintained that a "lack of expedited treatment could reasonably be expected to pose an imminent threat to the life and physical safety of thousands of residents in East Palestine and neighboring communities that may be exposed to

dangerous dioxins in the air, water, soil and in the dust in their homes following the burning of vinyl chloride and other chemicals.

"There is an urgency to inform the public about testing and sampling results and EPA action or inaction on dioxin testing, especially in light of the fact that the EPA's stance on dioxin contamination is in opposition to independent environmental scientists who have found very high levels of dioxins in the community," according to Government Accountability Project's FOIA.

In denying expedited processing, the EPA stated: "Your application does not provide enough details about the urgency to inform the public about agency records concerning dioxins. Many records about EPA involvement has (*sic*) been released on EPA's website. Additionally, your justification does not speak to any expectation that lack of expedited treatment would pose an imminent threat to the life or physical safety of an individual."

Government Accountability Project contends the people of East Palestine deserve the truth about the potential health and environmental impacts of the disaster and the EPA's internal processes. Government Accountability Project's FOIA also requests the full list of chemicals in the train cars that were burned—information that was released but later removed from the EPA's website.

"Incredibly, the industry-paid labs can't find chemicals, and the government says the public is safe," said Tom Devine, Government Accountability Project's legal director. "It is overdue to have an independent investigation to get a people's record of the truth. This investigation is a chance to learn the true extent of dangerous releases and make a record of those who live in East Palestine who have been harmed."

Hundreds of thousands of pounds of vinyl chloride and other toxic and flammable materials spilled February 3 when the Norfolk Southern train derailed. Then, on February 6, the chemicals burned for three days. Experts including former and current EPA officials have raised concerns that EPA did not consult with dioxin experts or test for dioxins for more than a month after the derailment.

Although EPA has insisted there were no public health threats from the accident and spill, informal reports indicate the agency may be covering up a public health tragedy.

"We are seeing blood in the urine, bloody noses, serious problems with menstrual cycles, rashes, and headaches in East Palestine as well as a seizure cluster and stroke like symptoms," said Smith, who has traveled to East Palestine 24 times since the derailment. "Currently, there is a seizure cluster in nearby Pennsylvania."

Government Accountability Project's investigation will make a record that was not purchased by industry, providing a voice for victims, Devine said.

"If you are sick, if your children are sick, we want to hear from you," Government Accountability Project's Environmental Investigator Lesley Pacey said. "If you have information that can aid our investigation, we want to talk with you. Government Accountability Project is the nation's largest and most prestigious whistleblower organization and getting at the truth while protecting truth tellers is what we do."

Pacey will be attending a live town hall in East Palestine, hosted by News Nation, on September 26 at 8:00 p.m. ET to meet members of the community and learn more about how this tragedy has impacted their lives. The town hall is being held to give residents and others impacted by the disaster a voice.

Experts agree the background level for dioxins in residential land use in soil averages 6 parts per trillion (ppt) on an index measure called Toxic Equivalency Factor (TEQ). However, Smith is finding measures of dioxins and furans in the soil in East Palestine in the range of 27–30 ppt—with some results considerably higher.

"This is highly concerning when you compare it to Times Beach, Missouri, a town that had to be evacuated in 1983 due to dioxin and other chemical contamination," Smith said. "Dioxins do not go away. They accumulate and migrate. It's called the 'body burden.' It's exposure over time. And when you clearly see the increased burden of dioxins in the soil and/or sediment and/or surfaces, it is a real-world concern."

Smith said that due to his dioxins findings, which he has shared regularly in the media, he has seen attempts by the EPA, Norfolk Southern, and its contractors to discredit him.

"Smear campaigns against me are nothing new. I've been to over 60 disasters. Sadly, it's part of the coverup playbook when a big company like Norfolk Southern and their battalion of lobbyists and public relations people get the EPA to follow their script, using what appears to be undue influence," Smith said. "The EPA is demanding to know why I test where I test and what my work plan and methodologies are. It's simple: My work plan is to test the property of any resident that the EPA is refusing to test. I test at the request of the residents. My sampling methodologies mirror the procedures and protocols that EPA personnel are executing in East Palestine."

"The questions are: 'What is the EPA hiding? Why did they not remediate the worst threat first? Why are they refusing to test residents' homes near the derailment? And why are they withholding EPA FOIA information?'" Smith asked.

About Scott Smith

Seventeen years ago, Scott Smith's life was turned upside down when his small business was wiped out in oil contaminated flood waters in St. Johnsville, N.Y. This event changed the trajectory of his life, and he shifted his focus to solving water contamination problems.

Additionally, Smith is an inventor named on 11 issued patents and 14 patent-pending applications relating to Open-Cell foam technology for testing/remediation of water, surfaces, and air contaminated with dangerous pathogens (e.g., MRSA, COVID-19, *Legionella*, C. diff), harmful algal blooms and related toxins, oil, and chemicals.

Now an independent testing expert and CEO of U.S. BioSolutions, Smith frequently works on the ground in the U.S. and abroad in contamination events supporting communities by investigating and helping affected communities diagnose and solve water contamination events.

His unique perspective as a CEO and community liaison brings his personal and professional experience to each contamination site. He is a graduate of Baylor University and Harvard Business School.

"I've been involved on the ground testing in over 60 disasters since 2006, beginning with my own disaster," said Smith, referring to torrential rains in 2006 that flooded his business, Cellect, LLC, with 15 feet of water causing his plastic foam factory in St. Johnsville, N.Y., to shut down for four months. His plant sustained $10 million in damage and lost revenue. The event brought him recognition as an exemplary employer.

After the disaster, he immediately organized a meeting with the New York State Department of Labor, quickly securing unemployment assistance for his 100 employees. After observing the care, concern and innovation that Smith displayed in getting his employees back to work in the aftermath of the flood and his devotion to the rebuilding and expanding the business, Sen. Chuck Schumer nominated Smith for – and he was later awarded – the Phoenix Award for Small Business Disaster Recovery in 2008 and described Smith as *"a fount of knowledge for a U.S. Senator."*

You can follow Smith on X (formerly Twitter) @WaterWarriorOne.

Contact: Andrew Harman, Government Accountability Project Communications Director
Email: andrewh@whistleblower.org
Phone: 202.926.3304

Government Accountability Project is the nation's leading whistleblower protection organization. Through litigating whistleblower cases, publicizing concerns and developing legal reforms, Government Accountability Project's mission is to protect the public interest by promoting government and corporate accountability. Founded in 1977, Government Accountability Project is a nonprofit, nonpartisan advocacy organization based in Washington, D.C.

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EXHIBIT 15

Mary Lightbody
Ohio House of Representatives
District 04
77 South High Street, 10th floor
Columbus, Ohio 43215

Kent Smith
Ohio Senate
District 21
1 Capitol Square
Columbus, Ohio 43215

September 22, 2023

President Joseph R. Biden
The White House
1600 Pennsylvania Avenue NW
Washington, DC 20500

Administrator Deanne Criswell
Federal Emergency Management Agency
500 C Street SW
Washington, DC 20024

RE: Request to Declare a Major Disaster in East Palestine, Ohio

Dear President Biden and Administrator Criswell:

We write to ask that you approve Ohio Governor Mike DeWine's July 3, 2023, Request for Presidential Declaration of Major Disaster or Emergency per the Stafford Act (42 USC 5170). This declaration would provide additional resources from the federal government that are needed to address the ongoing needs in East Palestine, Ohio, and the surrounding area.

Individuals who have signed below are members of the National Caucus of Environmental Legislators (NCEL), a nonpartisan network of state legislators who are working to protect, conserve, and improve the natural and human environment. NCEL recently convened in Indianapolis for our National Forum to share information about environmental issues and legislation.

In one of the sessions, we heard from Jami Wallace, the Founder, and President of the Unity Council for the East Palestine Train Derailment, about ongoing issues that families, and especially children, are experiencing. She shared neighbors and her personal story about the ongoing challenges faced by residents of East Palestine since February 3. These difficulties include continued displacement from their homes, exposure to toxic chemicals in the air and groundwater, and an onset of new health concerns. The long-term effects on residents of the hazardous chemical release are still not known.

This community feels overlooked and left behind as they continue to deal with these impacts and the consequences of misguided early decisions in the cleanup effort. We are concerned that so many highly toxic and carcinogenic chemicals were released into the soil, water, and air, and recognize the need for concerted efforts to remove all immediate and persistent risks to people and the environment.

Since the derailment, Senator Sherrod Brown and other members of the Ohio congressional delegation have made it a top priority to support the people of East Palestine, advance the cleanup effort, and address the railway companies' profit-focused lax safety. Members of the Ohio House and the Ohio Senate have worked on ensuring railroad safety and to prevent disasters like this from happening again. Pennsylvania Governor Josh Shapiro has ensured the provision of water testing from the

Pennsylvania Department of Environmental Protection, supported the fire crews who had their equipment damaged in the immediate aftermath, and worked to hold the railway accountable.

We appreciate that your administration has mobilized a multi-agency effort and that FEMA has been involved in remediation since the derailment. East Palestine needs additional FEMA assistance including programs and resources such as the Individuals and Households Program, the Crisis Counseling Program, the Disaster Unemployment Assistance Program, Disaster Legal Services, and Small Business Administration Disaster Assistance.

The people of East Palestine deserve clear answers and accurate information throughout the cleanup efforts. A state of emergency would help comprehensively address this disaster with additional technology and the help of experts with experience and expertise in cleaning up chemical spills of this size and nature. The residents of East Palestine and others across the watershed and region deserve that support.

On July 3, 2023, Governor DeWine sent a letter requesting a Major Disaster Declaration per the Stafford Act (42 USC 5170) to aid in East Palestine's recovery. We appreciate that the Governor made this request; however, the Governor has yet to receive a formal response from FEMA. Senator Sherrod Brown also sent a letter on August 7, 2023, in support of this declaration and to request additional information about the federal government's response. We write to support their requests in hopes that residents of East Palestine will not have to wait any longer for additional assistance from FEMA. It is abundantly clear that more resources are urgently needed to fully address the cost of the disaster on the people of this small community and the surrounding area. We must continue to support the people of East Palestine.

Thank you for your consideration.

Sincerely,

Ohio Representative Mary Lightbody, Ph.D.
(OH-4)

Ohio Senator Kent Smith
(OH-21)

Alabama Representative John Rogers
(AL-52)

Colorado Representative Cathy Kipp
(CO-52)

Alaska Representative Andy Josephson
(AK-13)

Colorado Representative Stephanie Vigil
(CO-16)

Alaska Senator Elvi Gray-Jackson
(AK-7)

Colorado Senator Sonya Jaquez Lewis
(CO-17)

Arizona Senator Juan Mendez
(AZ-8)

Colorado Senator Dafna Michaelson Jenet
(CO-21)

Connecticut Representative David Michel
(CT-146

Connecticut Representative Geraldo Reyes
(CT-75)

Connecticut Representative Kevin Ryan
(CT-139)

Georgia Representative Kim Schofield
(GA-63)

Georgia Senator Tonya Anderson
(GA-43)

Hawaii Representative Amy Perruso
(HI-46)

Illinois Senator Laura Fine
(IL-9)

Illinois Senator Rachel Ventura
(IL-43)

Maine Representative Arthur Bell
(ME-103)

Maine Representative Sophia Warren
(ME-124)

Maryland Delegate Lorig Charkoudian
(MD-20)

Maryland Delegate Jheanelle Wilkins
(MD-20)

Michigan Representative Laurie Pohutsky
(MI-17)

Minnesota Representative Sydney Jordan
(MN-60)

Minnesota Representative Lucille Rehm
(MN-48)

New Hampshire Representative Susan Almy
(NH-58)

New Hampshire Representative Maria Perez
(NH-102)

New Mexico Representative Joanne Ferrary
(NM- 37)

North Carolina Representative Pricey Harrison
(NC-61)

North Carolina Representative Julia Von Haefen
(NC-36)

Oregon Senator Janeen Sollman
(OR-15)

Rhode Island Representative Jennifer Boylan
(RI-66)

Rhode Island Representative Lauren Carson
(RI-75)

Rhode Island Representative Rebecca Kislak
(RI-4)

Rhode Island Representative Michelle McGaw
(RI-71)

Rhode Island Representative Teresa Tanzi
(RI-34)

Utah Representative Joel Briscoe
(UT-24)

Vermont Representative Esme Cole
(VT-105

Virginia Delegate Kaye Kory
(VA-38)

EXHIBIT 16

OFFICE OF INSPECTOR GENERAL
U.S. ENVIRONMENTAL PROTECTION AGENCY

September 25, 2023

MEMORANDUM

SUBJECT: Results of Inquiry into the East Palestine Derailment
Project No. OSRE-FY23-G-0058

FROM: Lauretta Joseph, Director
Programs, Offices, and Centers Oversight Directorate
Office of Special Review and Evaluation

TO: Debra Shore, Regional Administrator
EPA Region 5

The U.S. Environmental Protection Agency Office of Inspector General has completed the subject inquiry into the EPA's response to the February 3, 2023 train derailment in East Palestine, Ohio. We initiated this inquiry as a preliminary step to determine whether additional oversight work was needed. In this memorandum, we highlight observations that we identified during the inquiry. No additional oversight work is planned at this time, but we will continue to monitor developments and reassess as necessary.

Our primary observation is that the EPA could enhance its risk communication methods to clearly communicate to the public which chemicals are being sampled or monitored, why they are being sampled or monitored, and when and why sampling or monitoring stopped. We note that the EPA's work related to the East Palestine incident is ongoing, and we intend our observations to inform the Agency's future response actions. We plan to meet with Agency staff to discuss our observations in detail.

We will post this memorandum on our public website at www.epaoig.gov.

Background

At approximately 8:55 p.m. EST on February 3, 2023, a freight train derailed in East Palestine, Ohio, about a quarter mile west of the Ohio–Pennsylvania state line. The train company reported the incident to the National Response Center at 10:53 p.m. The EPA arrived on-site by 2 a.m. on February 4, 2023. Of the 150 railcars on the train, about 50 derailed. Twenty of the affected railcars contained hazardous materials, including vinyl chloride, ethylene glycol, ethylhexyl acrylate, butyl acrylate, and isobutylene. Some railcars caught fire, and some spilled their loads into an adjacent ditch that eventually feeds into the Ohio River. To prevent a potential explosion, the train company performed a controlled burn of five rail cars containing vinyl chloride on February 6, 2023. As of August 2023, the EPA was still conducting its response activities at the East Palestine site and, according to EPA staff, was supporting its local and state partners that were leading the on-the-ground response efforts.

Observations

We initiated our inquiry based on concerns regarding how effectively the EPA was addressing air and water emissions from the East Palestine crash and subsequent fire and whether the shipment of hazardous waste and wastewater from the incident site followed established procedures, such as adhering to federal hazardous waste requirements when shipping hazardous waste off-site for disposal. The EPA's activities resolved many of our concerns. However, during our inquiry, we identified ways the EPA could improve future disaster responses, including better risk communication about sampling and monitoring efforts.

Hazardous Waste and Wastewater Shipments

One of the EPA's responsibilities when responding to a disaster is conducting removal actions to protect human health and the environment, such as shipping hazardous waste and wastewater from the disaster site to permitted hazardous waste facilities. There were some initial procedural issues with shipments of hazardous waste from the East Palestine site. The EPA said that it was informed that some states were seeking to block shipment of hazardous waste to their states from the East Palestine site. On March 17, 2023, the EPA sent a letter to all 50 states informing them that, if they blocked hazardous waste shipments, they would likely be violating not only federal law but the Commerce Clause of the U.S. Constitution, which the Agency said limits the power of states to stop the movement of hazardous waste. As of August 2023, hazardous waste continued to be shipped without incident from Ohio to at least three other states. Another procedural issue involved the shipment of wastewater from the East Palestine site. According to EPA staff, they initially explored shipping wastewater to permitted sewage treatment plants. However, due to public opposition, this option was not pursued, with all wastewater instead being shipped off-site as hazardous waste.

Risk Communication

When responding to disasters that involve hazardous chemicals and pollutants, the EPA coordinates and implements a range of activities, including sampling the air, soil, and water at the disaster sites to monitor the levels of such chemicals and pollutants. The EPA is also responsible for communicating its sampling and monitoring efforts, as well as the resultant data, to the public. In East Palestine, the EPA held public meetings, distributed a newsletter every two weeks, and created a Community Welcome Center where residents could speak with EPA team members and get their questions answered. However, we observed that the EPA did not clearly communicate why it sampled for or monitored certain chemicals. The EPA also did not communicate when and why it stopped sampling or monitoring, such as when concentrations fell below minimal risk levels. And while the EPA's East Palestine website contains raw air sampling data, as of August 2023 it did not state or indicate whether measured pollutant concentrations exceeded screening levels or even what those screening levels are.

Key Terminology

Minimal Risk Levels: "[E]stimate of the amount of a chemical a person can eat, drink, or breathe each day without a detectable risk to health. MRLs are developed for health effects other than cancer."
Agency for Toxic Substances and Disease Registry website, "Minimal Risk Levels (MRLs)"

Screening Levels: "Chemical-specific concentrations for individual contaminants in air, drinking water, and soil that may warrant further investigation or site cleanup when exceeded."
EPA, Regional Screening Levels (RSLs) - User's Guide, May 2023

We also noted multiple instances of inconsistencies in the air monitoring and sampling data on the EPA's East Palestine website, including:

- The number of monitors on the EPA's website not matching the number on an internal Agency map of monitors.
- A data cell with a footnote number without a corresponding footnote.
- Screening level results that appear to be off by one decimal place.
- Exceedances and missing data on the concentrations and public health impact of acrolein, a hazardous air pollutant that was presumably created by the burning of other chemicals during the incident. We will continue to monitor developments regarding acrolein and consider, as necessary, the need for additional oversight.

While minor when taken individually, these inconsistencies could, when taken together, erode public trust in the data communicated. In past reports, we have stressed the importance of accurate and easily understood risk communication by the Agency:

- In a 2021 report on communicating health risks at contaminated sites, we concluded that the "EPA needs to improve its risk communication efforts and deliver accurate, timely risk messages that are appropriate for the affected communities."
- In a 2023 report on the closure of the Red Hill facility in Hawaii, we concluded that the EPA should ensure that groundwater monitoring information communicated to the public is easy to understand.
- In our report detailing the EPA's top management challenges for fiscal years 2020 and 2021, we noted that one of the Agency's challenges is communicating risk to allow the public to make informed decisions about its health and environment. We also identified risk communication as a top management challenge for the Agency in fiscal years 2022 and 2023, although it was incorporated into the broader challenge of "integrating and leading environmental justice across the Agency and government."

The EPA's "Seven Cardinal Rules of Risk Communication," which the Agency issued in April 1988, states that one rule of risk communication is to accept and involve the public as a legitimate partner. We continue to stress the importance of the Agency providing accurate, comprehensible, and timely information to the public.

cc: Janet McCabe, Deputy Administrator
Dan Utech, Chief of Staff, Office of the Administrator
Wesley J. Carpenter, Deputy Chief of Staff for Management, Office of the Administrator
Faisal Amin, Agency Follow-Up Official (the CFO)
Cheryl Newton, Deputy Regional Administrator, Region 5

Andrew LeBlanc, Agency Follow-Up Coordinator
Susan Perkins, Agency Follow-Up Coordinator
Jeffrey Prieto, General Counsel
Tim Del Monico, Associate Administrator for Congressional and Intergovernmental Relations
Nick Conger, Associate Administrator for Public Affairs
Stefan Martiyan, Director, Office of Continuous Improvement, Office of the Chief Financial Officer
Michael Benton, Audit Follow-Up Coordinator, Office of the Administrator
Dale Meyer, Acting Audit Follow-Up Coordinator, Region 5
Nina Johnson, Audit Follow-Up Coordinator, Region 5

EXHIBIT 17

United States Senate

WASHINGTON, DC 20510

September 26, 2023

The Honorable Michael Regan
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, DC 20460

Dear Administrator Regan:

As you are aware, on the night of February 3, 2023, multiple Norfolk Southern train cars derailed in East Palestine, Ohio, less than one-quarter mile from the Ohio-Pennsylvania border. We write to inquire about section 104(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, 42 U.S.C. 9601 et seq.) and to encourage you to examine the feasibility of making a determination under this authority, as directed by the Executive Order issued on September 20th, 2023[1]. If applicable, such a determination could provide residents of East Palestine with much-needed, additional resources, including Medicare coverage, as they cope with the lingering impacts of this preventable, man-made crisis by Norfolk Southern.

According to the U.S. Environmental Protection Agency (EPA), twenty of Norfolk Southern's affected railcars contained hazardous materials, including vinyl chloride, butyl acrylate, 2-ethylhexyl acrylate, and ethylene glycol monobutyl ether. In the days after the incident, a decision was made by the Unified Command to vent and burn five tank cars containing vinyl chloride in order to avoid a potential explosion. This vent and burn released additional dangerous chemicals into the air, water, and soil of East Palestine and surrounding communities. The long-term environmental and public health impact of this exposure on residents remains unknown and may not become apparent for years to come. Given this uncertainty, even after clean-up activities are completed, residents' concerns will remain about potential harms caused by exposure to the dangerous chemicals released as a result of the derailment.

Under CERCLA section 104(a), it is our understanding that the administration may make a determination of a public health emergency based on hazardous environmental exposures, which could provide for additional resources to the impacted communities such as allowing the U.S. Department of Health and Human Services to utilize its authority under section 1881A of the Social Security Act (42 U.S.C. §§ 301-1307) to provide individuals exposed to certain environmental health hazards or diagnosed with a health condition related to an environmental exposure access to Medicare coverage. This Medicare coverage would help ensure residents of East Palestine, Ohio, and the surrounding communities impacted by the derailment and resulting

[1] https://www.whitehouse.gov/briefing-room/statements-releases/2023/09/20/fact-sheet-president-biden-issues-executive-order-to-protect-people-in-east-palestine-ohio-and-nearby-communities-and-continue-to-hold-norfolk-southern-accountable/

chemical exposures have access to the long-term medical care that they deserve in the wake of this environmental disaster.

We understand that federal, state, and local monitoring and assessment activities currently report that the air, ground water, and drinking water in East Palestine and surrounding communities is safe. However, we cannot disregard the long-term potential for contaminants to migrate and impact surface, ground, or drinking water in the region, or preclude the emergence of serious medical conditions linked to the exposure of environmental contaminants from the derailment over the long-term. Therefore, we request the EPA explore the applicability of section 104(a) of CERCLA to make a determination whether the crisis caused by Norfolk Southern's derailment meets the criteria of a public health emergency under the law. If EPA has already examined its authorities under section 104(a) of CERCLA, we request detailed information on why a determination has not been issued.

No affected resident of East Palestine or its surrounding communities should have to worry about affording necessary health care, now or in the future. It is incumbent on us to explore using every tool available to the federal government in the service of that goal – including utilization of section 104(a) of CERCLA.

Thank you for your prompt attention to this critical matter.

Sincerely,

Sherrod Brown
United States Senator

JD Vance
United States Senator

EXHIBIT 18

JD VANCE
OHIO

United States Senate
WASHINGTON, DC 20510

COMMITTEE ON BANKING, HOUSING, AND URBAN AFFAIRS
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
SPECIAL COMMITTEE ON AGING
JOINT ECONOMIC COMMITTEE

September 28, 2023

Ms. Jami R. Wallace, J.D., M.P.A.
President
East Palestine Unity Council
East Palestine, OH 44413

Ms. Hilary Flint
Vice President
East Palestine Unity Council
East Palestine, OH 44413

Dear Ms. Wallace and Ms. Flint:

I write to thank you for your letter of August 15, 2023. Your visit to Washington at the end of July is still fresh in my memory, and I am proud to say that my staff and I have been working to bring federal support to East Palestine ever since. As you say, the East Palestine train derailment has had very real human costs, and we cannot let our political differences prevent us from working together to help the community recover.

Your letter urges me to join with Senator Brown on a letter calling for the Biden administration to deliver federal resources to East Palestine. I am happy to say that I will be joining with Senator Brown to do exactly that. On September 26, we sent a bipartisan letter to the Biden administration's EPA, urging it to issue a public health emergency declaration for East Palestine that could unlock federal healthcare resources for affected residents.

Your letter also asks that I urge President Biden to visit East Palestine personally and witness the staggering human costs of the derailment firsthand. Again, I am happy to oblige. I have already made that case publicly on a number of occasions, including on a television appearance at the end of August. And, because I believe that President Biden will not be able to truly support East Palestine until he sees the community for himself, I will continue to make that case until President Biden visits and much-needed federal support is delivered.

Again, I thank you for keeping me abreast of the urgent needs of my constituents in and around East Palestine. I look forward to working together to solve problems for, and deliver relief to, those affected by this disaster. I am aware that you forwarded a number of specific concerns to my staff, and I have instructed them to discuss those concerns with you in a phone call or meeting at the first opportunity.

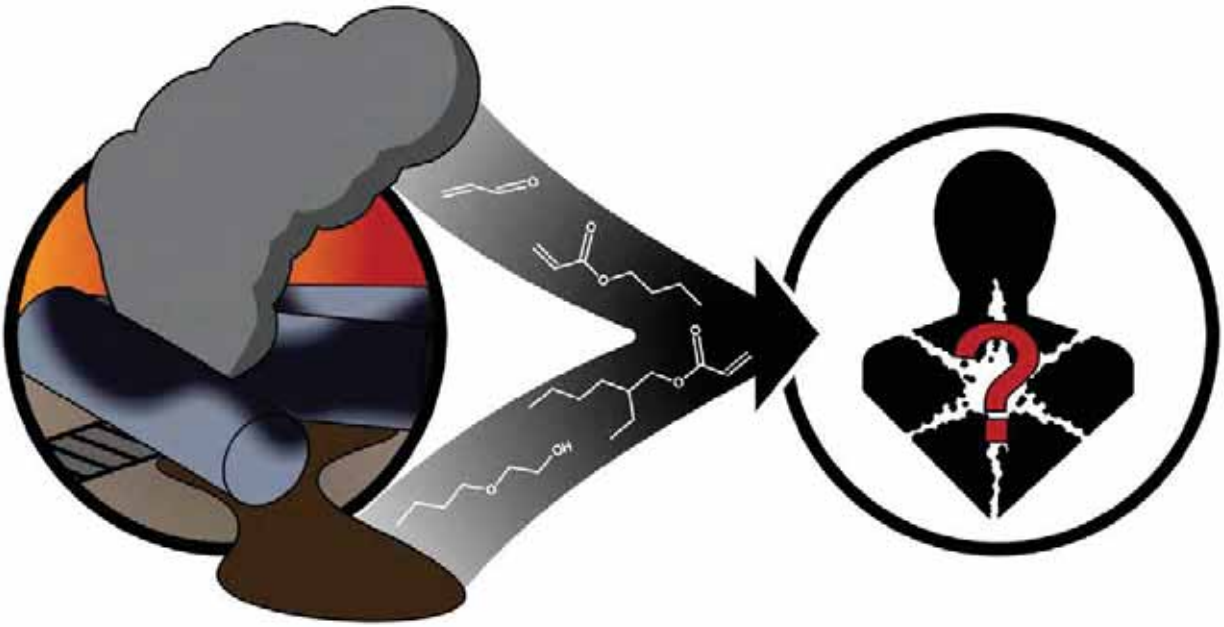
Sincerely,

JD VANCE
United States Senator

EXHIBIT 19

Rapid Scoping Review of East Palestine, Ohio Chemicals of Interest

October 2023



National Institute of Environmental Health Sciences
Your Environment. Your Health.

Disclaimer: The information in this draft Rapid Scoping Review has not undergone external peer review and should not be construed to represent any NIEHS determination or policy.

About This Report

National Institute of Environmental Health Sciences[1]
[1]Division of Translational Toxicology, Research Triangle Park, North Carolina, USA

This work was supported [in part] by the Intramural Research Program of the NIH and by Contract GS00Q14OADU417 | Order HHSN273201600015U

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---

[2]Left NIEHS October 2023 and is currently the Director of North Carolina State University's Center for Human Health and the Environment. Also currently serving as a special volunteer at NIEHS.

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Table of Contents

Acronyms and Abbreviations

ACE	Assessment of Chemical Exposures
AEGL	Acute Exposure Guideline Levels for Airborne Chemicals
AR-AFFF	Alcohol Resistant Aqueous Film Forming Foam
ATSDR	Agency for Toxic Substances and Disease Registry
BMD	Benchmark Dose
BMDL	Lower 95% Confidence Limit of the Benchmark Dose
CalEPA	California Environmental Protection Agency
CASRN	Chemical Abstracts Service Registry Number
CDC	Centers for Disease Control and Prevention
CNS	Central Nervous System
CompTox	CompTox Chemicals Dashboard
CSF	Cancer Slope Factors
DNEL	Do Not Exceed Limits
DR2	Disaster Research Response Network
ECB	European Chemicals Bureau
ECHA	European Chemicals Agency
EECO	Evidence Stream, Exposure, Comparator, and Outcome
EPA	Environmental Protection Agency
IARC	International Agency for Research on Cancer
IRIS	Integrated Risk Information System
LD50/LC50	Lethal Dose or Concentration at which 50% of the population does not survive
MeSH	Medical Subject Headings
MRL	Minimal Risk Levels
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicology Program
OEHHA	CalEPA Office of Environmental Health Hazard Assessment
OR	Odds Ratio
PECO	Population, Exposure, Comparator, and Outcome
PFAS	Per- and polyfluoroalkyl substances
POD	Points of Departure
RA	Risk Estimate Available
REL	Recommended Exposure Limits
RfC	Reference Concentration
RfD	Reference Dose
SR	Systematic Review
TAMU	Texas A&M University
TCDD	Tetrachlorodibenzo-p-dioxin

Rapid Scoping Review of East Palestine, Ohio Chemicals of Interest

Introduction

Questions on the potential health effects from exposures associated with emergencies (e.g., disasters), emerging environmental contaminants, and novel human health concerns with unknown origins occur unexpectedly, yet regularly, and decision makers depend on timely access to high-quality, actionable information to protect public health. To respond effectively to disasters involving large-scale chemical releases and emerging contaminant issues and to provide information to communities, scoping reviews and systematic reviews (SRs) are critical resources to identify what we know about potential health effects, what we do not know, and thereby judge what we need to know. This information can also help in risk communication to affected communities, who have the right to know the potential short- and long-term health effects associated with exposure to chemicals they may not have heard of previously.

On February 3, 2023, a Norfolk Southern Railway general merchandise freight train derailed, releasing vinyl chloride and other hazardous chemicals into the environment in East Palestine, Ohio. Three days later, first responders conducted a controlled burn to prevent an explosion, releasing volatile organic compounds (e.g., acrolein, benzene) into the air and potentially leaving other residual chemicals in the soil. Unified Command, led by the Environmental Protection Agency (EPA), local/state government, and academic researchers (e.g., the Disaster Research Response [DR2] Network) have monitored—and continue to monitor—the air, soil, and water for chemicals of interest and untargeted analyses (not all of which has been shared publicly yet). Updates on available monitoring data are published for public access on EPA's East Palestine, Ohio Train Derailment webpage. Preliminary results from the Assessment of Chemical Exposures (ACE) Survey, administered by the Agency for Toxic Substances and Disease Registry (ATSDR) in conjunction with the Ohio and Pennsylvania Departments of Health, found that residents, Centers for Disease Control and Prevention (CDC) survey workers, and first responders reported short-term adverse symptoms (e.g., headaches, respiratory effects) consistent with acute chemical irritant exposure, mental health symptoms, and concerns about long-term health effects. Health agencies, the community, and others are concerned about potential long-term effects.

Objective: To inform potential future research on health effects and facilitate communication with affected communities, we conducted a phased scoping and rapid SR of health hazard information for the East Palestine chemicals of interest.

Methods

Overall Methods

This project included the following phases, which were iterative:

1. Scoping and visualization: Identification of chemicals of interest (Phase 1a)
2. Scoping and visualization: Summary of authoritative review conclusions on selected health outcomes for chemicals of interest (Phase 1b)
3. Targeted literature searching and screening: Summary of literature reviews and primary studies regarding key research gaps contributing to uncertainty on potential health effects for higher-priority (i.e., highest- and high-priority) chemicals (Phase 2)

A rapid SR may be conducted if Phase 2 scoping identifies any chemicals and health outcomes with an adequate database.

Identification of Chemicals of Interest

For this first phase, all the chemicals released during the train derailment and response with possible human exposures were chemicals of initial interest. We identified 15 chemicals of initial interest to review for available health effects data. These chemicals were released during the train derailment (N = 12) and from the controlled fire (N = 3), and the list of chemicals came from publicly available media sources (consistent with the Texas A&M University (TAMU) DR2 unit list), and internal communications (see Appendix B, Table B-1.). Subsequently, isobutylene was removed from the list based on correspondence with EPA clarifying that the train car carrying this chemical did not spill or burn.

Next, we conducted an initial prioritization (i.e., high vs. low) of the 15 chemicals to identify those with a higher likelihood of potential human exposure following release during the train derailment and/or subsequent fire. Available monitoring data and informal discussions were considered in this prioritization. The priority chemicals from this list included acrolein, benzene, butyl acrylate, ethylene glycol monobutyl ether ("2-butoxyethanol"), 2-ethylhexyl acrylate, hydrogen chloride, phosgene gas, and vinyl chloride. All chemicals were reviewed for available health-related evidence.

To extinguish the controlled burn, the fire was smothered in approximately 20 gal. of T-STORM F-787A alcohol resistant aqueous film forming foam (AR-AFFF) diluted in water. The product is manufactured by Williams Fire/Ansul and believed to contain per- and polyfluoroalkyl substances (PFAS) typical of other Ansul products (e.g., 6:2 FTNO [CASRN 80475-32-7], 6:2 FTSHA [CASRN 88992-45-4], 6:2 FTSAS [CASRN 88992-47-6], 6:2 FTSA [27619-97-2], 6:2 FTSA-PrB [CASRN 34455-29-3]) (Houtz et al. 2013; Place and Field 2012; Ruyle et al. 2021). According to the Safety Data Sheet, it also contained 4%–7% v/v diethylene glycol monobutyl ether. Common smaller chain breakdown products of these PFAS have been reported (Harding-Marjanovic et al. 2015; Ruyle et al. 2021; Yi et al. 2018), and some terminal PFAS (those that will not further breakdown) are estimated to stay in the environment for up to a century without remediation (Ruyle et al. 2023). There is a high probability that other products such as 2-(2-butoxyethoxy)ethanol [CASRN 112-34-5] and laurylamidopropyl betaine [CASRN 4292-10-8] were in this product (identified in other Ansul products) and may be a fairly large proportion of the remaining volume (Ruyle et al. 2021). Ultimately, the five PFAS (6:2 FTNO, 6:2 FTSHA, 6:2 FTSAS, 6:2 FTSA, and 6:2 FTSA-PrB) suspected to be in the AR-AFFF that was used to extinguish the burn were also included in this review.

Box 1. Authoritative Sources Reviewed for Hazard Conclusions

- CalEPA OEHHA Chemical Summaries
- CDC's ATSDR Toxicological Profiles
- ECHA Risk Assessment Reports and Toxicological Summaries
- EPA's CompTox Dashboard
- EPA's IRIS Assessments
- Health Canada's Priority Substances List Assessment Reports
- IARC Monographs
- National Academies' AEGL Reports (select chemicals)
- NIOSH Chemical Pocket Guides
- NTP carcinogenicity, genotoxicity, and teratology results

Although EPA and others have detected numerous other chemicals in the environment (air, soil, and water) as part of East Palestine-related monitoring activities, it is unclear whether those additional elevated chemicals are related to the East Palestine spill or may have been there prior to the train derailment. We are actively engaging with relevant government agencies (and respective websites) and academic communities to identify additional chemicals related to the East Palestine train derailment and may conduct additional scoping for other relevant chemicals.

Phase 1: Summary of Authoritative Review Conclusions

To inform our understanding of potential health effects and key data gaps for the chemicals of interest, including the five PFAS, we searched for and extracted data on human health hazards available from selected authoritative sources (see Box 1). The National Academies' Acute Exposure Guideline Level (AEGL) Reports were extracted for select chemicals (phosgene gas and hydrogen chloride) after identifying data gaps.

Data from the authoritative sources were extracted for the health outcome categories listed in Box 2. Human health hazard conclusions were prioritized for extraction, along with human-relevant risk estimates (e.g., cancer slope factors [CSF], minimal risk levels [MRL], reference doses [RfD], reference concentrations [RfC], recommended exposure limits [REL], do not exceed limits [DNEL]). If human health hazard conclusions or risk estimate values were not available, we made note of available toxicity values (e.g., points of departure [POD], lethal dose or concentration at which 50% of the study population does not survive [LD50 or LC50]) and critical effects. If none of the above information was available, we noted if human and/or animal data were available for the category.

Box 2. Health Outcome Categories for Data Extraction

Cancer[a]	Immune[a]
Cardiovascular[b]	Nervous[a]
Developmental[a]	Ocular[a]
Endocrine	Renal[b]
Gastrointestinal[b]	Reproductive[a]
Genotoxicity	Respiratory irritation[a]
Hematological[b]	Skin irritation/sensitivity[a]
Hepatic[b]	Systemic[b]

[a]Major health outcomes
[b]Less reported health outcomes

We completed data extraction in Microsoft Excel. In addition to publication information (e.g., source name, access link, date of publication), we extracted the following information for each health effect category (when applicable): hazard conclusion or risk estimate and critical effect, evidence type (e.g., human or animal), duration and route of exposure, and additional relevant information (as necessary). A primary extractor reviewed and extracted the health effects data from all sources for each chemical, and the extraction was checked for completeness and accuracy by a secondary extractor.

Following initial extraction, we compiled results into a summary file to better understand data gaps across the chemicals and health outcome categories. For each chemical, we compiled major health hazard conclusions and relevant risk estimates in summary lists and included information on available data for the major health outcome categories presented in Box 2. We also included a list of authoritative sources (with links to web pages) with available data for each chemical.

We conducted additional targeted searches in the Causaly platform (accessible at: https://www.causaly.com/) for all chemicals using the term "diseases affected" by chemical name. Causaly leverages artificial intelligence to rapidly search the body of available biomedical literature for a given chemical and, therefore, provides timely output. The output provides a list of health outcome categories identified in the published literature for the chemical, the projected relationship between the chemical and the health outcome (e.g., upregulated, downregulated, bidirectional), and the citation for the published literature. These outputs from Causaly should be considered with caution, as we were unable to determine whether studies or data on specific health evidence were missing from the results. However, our use of a phased approach, starting with an assessment of authoritative reviews for each chemical, increases confidence that major health effects data were captured. When Causaly identified relationships between a priority chemical and a health outcome, we compared those results with the gaps identified from authoritative source reviews. If the Causaly results indicated an identified gap may have available literature, we reviewed the citations to better understand the available evidence. Based on this information, we prioritized additional health outcome categories as suggestive data gaps.

Identification of Key Research Gaps

We used the integrated extraction results in the summary file to identify health effect data gaps for each chemical (see Results and Discussion below). Specific chemical and health outcome ("chemical × health outcome") research gaps were considered for additional targeted searches in PubMed®.[3] Chemical × health outcome research gaps were further prioritized and selected according to the following

[3]Note that given the rapid nature of the review, a single bibliographic database was searched; PubMed was selected due to its broad coverage of health effects research.

criteria:

1. Initial priority of the chemical based on potential for human exposure following release (see Identification of Chemicals of Interest). Higher-priority chemicals were considered for additional review.
2. Hazard conclusion data available. Chemical × health outcome pairings with gaps (i.e., those that lacked definitive conclusions or had no or few studies) were candidates for additional literature searches.
3. Recency of available hazard conclusion. Chemicals with recent (i.e., published 2022–2023) reviews from authoritative sources that reported hazard conclusions were not prioritized. In contrast, chemicals with few studies from older reviews were prioritized.

Phase 2: Targeted Literature Searches and Screenings

Literature Searches

In Phase 2, literature searches were conducted to identify primary and review articles relevant to the chemical × health outcome pairings identified in Phase 1 reviews. Given the goals of this rapid review, a comprehensive literature search (e.g., using chemical names, synonyms, and CASRNs for all health effect-related studies across multiple bibliographic databases) and screening approach to identify relevant literature was not undertaken. Instead, two approaches were employed in Phase 2: first, targeted searches were conducted in PubMed to identify review articles on a given topic; then, additional searches were conducted in PubMed to identify primary articles published on the topic. If the search for reviews returned ≤20 results, the search for primary articles was immediately conducted. If the search for reviews returned >20 results, the need for a subsequent search to identify primary literature was assessed by the review team.

Terms to identify the appropriate chemical, health outcome, evidence type (e.g., human or animal), and study type were used to search for relevant primary and review articles.

1. Separate chemical search strings were developed for each chemical of interest. Chemical search terms were identified through EPA's CompTox Dashboard chemical synonym lists, which classifies the quality of listed synonyms as "Valid," "Good," and "Other." Each chemical was searched, and synonyms listed as "Valid" and "Good" were captured for the search string. The chemical was also searched in PubMed's Medical Subject Headings (MeSH) thesaurus to identify and retrieve indexing terms.
2. Search terms for each health outcome, evidence type, and epidemiological study design were identified using SWIFT-Review's publicly available Search Strategies Word documents (Sciome 2023) and the National Toxicology Program's (NTP's) Report on Carcinogens literature search approach (NTP 2015). Terms were then translated into the appropriate syntax for use in PubMed.

Strings were compiled according to chemical × health outcome pairings that were based on Phase 1 results (see Figure 1 and Figure 2; Appendix A, Table A-1). Additionally, when selecting chemical and health outcome pairings, we identified whether searches should target review or primary articles and designated which searches should return human vs. animal evidence. Search strings were adapted accordingly and are available in Appendix A.

Searches for designated chemical × health outcome pairings were conducted in PubMed in June and July 2023. For a given chemical × health outcome pairing, if the Phase 1 results included a recent authoritative review (i.e., published in 2019 through June/July 2023), a date restriction was added to the search to identify studies published after the authoritative review publication date and up to June or July 2023 when searches were conducted. Table 1 provides a list of conducted searches, and the Population, Exposure, Comparator, and Outcome (PECO) criteria used to guide the Phase 2 screening are available in Table A-1.

Following Phase 1 extractions, we anticipated that limited published literature would be available on the

five PFAS of interest for Phase 2 and sought information from EPA about ongoing reviews of the available literature for a variety of PFAS. Recent EPA literature reviews returned no literature for 6:2 FTSHA, 6:2 FTSAS, or 6:2 FTSA-PrB. As a result, we did not pursue these chemicals further. 6:2 FTNO was not represented in any of the existing EPA literature reviews, and 6:2 FTSA was included in a PFAS systematic evidence map published by EPA in 2022 (Carlson et al. 2022). To identify additional information about these chemicals, we conducted a nonrestricted literature search for 6:2 FTNO and a literature search to identify publications post-dating EPA's most recent search for 6:2 FTSA. Searches were conducted in PubMed in August 2023. Chemical search strings were developed using the approach outlined above, but searches were not otherwise restricted by health outcome category, evidence type, or study type in order to identify as much available literature as possible. Literature search details and results for relevant PFAS are included in Table 1.

Title-Abstract Screening

For title-abstract screening, results from literature searches were uploaded to DistillerSR, a platform for literature screening and management. Results from each chemical × health outcome search were screened completely before moving to the next pairing. For each reference, one screener reviewed the title and abstract and indicated PECO relevance. References were tagged as supplemental if a comparator population was not included (e.g., case reports/series, worker surveillance studies). References without an abstract were screened based on the title only. Ten percent of all excluded references were reviewed by a senior-level screener as a quality control and assurance measure. Full-text documents for relevant or supplemental references identified during title-abstract screening were retrieved by expert librarians.

Full-text Review and Extraction

References deemed PECO relevant or supplemental at the title-abstract level were reviewed at the full-text level in DistillerSR, which included an additional screening using the PECO criteria. Relevant and supplemental references also underwent tagging and data extraction. For relevant review articles and primary studies, information was extracted on the publication type, study design, evidence type, population characteristics (human), exposure conditions (animal), health outcomes, and findings.

Screeners were instructed to capture the most informative data on observed effects/conclusions to best capture the overall findings of each publication. For example, if a study reported a significant effect as a main finding alongside other null or nonsignificant results, the significant effect was extracted along with a summary of the other findings.

Data extraction was conducted by a primary screener and then reviewed by a senior-level screener for quality control and assurance purposes.

Supplementary Searches

During the scoping and review phases, additional monitoring data revealed elevated levels of dioxins in soil samples obtained from East Palestine. While not included in our initial scoping efforts, we conducted supplementary searches to identify available information on each chemical.

First, we conducted high-level searches to understand how authoritative sources from Phase 1 presented information on the health effects of dioxins. The web pages of select authoritative sources (ATSDR, California Environmental Protection Agency [CalEPA] Office of Environmental Health Hazard Assessment [OEHHA], European Chemicals Agency [ECHA], EPA CompTox and Integrated Risk Information System [IRIS], Health Canada, International Agency for Research on Cancer [IARC], and National Institute for Occupational Safety and Health [NIOSH]) were searched using the term "dioxins," and resources with relevant health information were identified. As dioxins are frequently discussed as a class rather than individual chemicals, we also noted how these resources referred to dioxins (e.g., whether information was provided only at the class level or whether information was provided for individual chemicals).

Next, to identify available information in recent peer-reviewed literature, we conducted a targeted search in PubMed. Search terms for dioxins were used to identify SRs and meta-analyses published from August 2018 through August 2023. Searches were conducted in August 2023 and were not restricted by evidence type or health outcome terms to identify as many results as possible. Titles of search results were screened to identify references discussing dioxins and health effects.

Results and Discussion

Phase 1

We integrated the extracted health outcome data for the initial 15 chemicals from each authoritative source (see Appendix B) to create an overview/map of the evidence (see Figure 1 and Table B-1.). The map provides information on whether, for each chemical, there is a health hazard conclusion and, if so, the confidence of the evidence or severity of the outcome (e.g., higher, moderate, lower) stratified by chemical priority (see Methods). If authoritative conclusions were not available, the map indicates whether the studies in the reviewed sources suggested an association with the health outcome or whether no/few studies were available. Determinations from the targeted Causaly searches were also incorporated for select chemicals (acrolein; 2-butoxyethanol; diethylene glycol; dipropylene glycol; hydrogen chloride; and 1,2 propylene glycol). See Figure 2 and Table B-2 for the overview/map of integrated health outcome data from authoritative sources for the five PFAS. Access information for the full data extraction Excel files is available in Appendix B.

Figure 1. Summary of Findings from Phase 1 Authoritative Source Reviews for 15 East Palestine Chemicals of Interest

No Conclusion		Conclusion Available[a]					
NS	ES	NL	IE	LA	LC	MC	HC
No or Few Studies	Evidence Suggestive	Not Likely Risk	Inadequate Evidence	Limited Animal Evidence	Lower Confidence or Severity	Moderate Confidence or Severity	Higher Confidence or Severity

Chemical (CASRN)	Cancer	Noncancer					Irritants/Sensitizers			
		Nervous	Immune	Developmental	Reproductive	Other Organs	Skin Sensitization	Skin Irritation	Eye Irritation	Respiratory Irritation
Highest-priority Chemicals										
Acrolein (107-02-8)	MC	ES	ES	NL	NL	MC / ES	ES	HC	HC	HC
Butyl Acrylate (141-32-2)	IE	NS	NS	NL	NL	ES	HC	HC	HC	MC
2-Butoxyethanol (EGBE) (111-76-2)	LA	ES	ES	NL	NL	HC / LC	NL	HC	HC	HC
2-Ethylhexyl Acrylate (103-11-7)	LC	NS	NS	NL	NL	NS	HC	HC	HC	HC
High-priority Chemicals										
Benzene (71-43-2)	HC	MC	HC	MC	LC	HC	NL	HC	HC	ES
Hydrogen Chloride (7647-01-0)	IE	NS	NS	NS	NS	ES	NL	HC	HC	HC
Phosgene Gas (75-44-5)	NS	NS	ES	NS	NS	HC	NS	HC	HC	HC

Chemical (CASRN)	Cancer	Noncancer					Irritants/Sensitizers			
		Nervous	Immune	Developmental	Reproductive	Other Organs	Skin Sensitization	Skin Irritation	Eye Irritation	Respiratory Irritation
Vinyl Chloride (75-01-4)	HC	MC	LC	LC	NS	MC	HC	HC	HC	HC
Moderate-priority Chemicals										
Diethylene Glycol (111-46-6)	NL	ES	NS	NL	NL	ES	NL	NL	NL	NS
Dipropylene Glycol (25265-71-8)	NL	NS	NS	NL	NL	NS	NL	LC	LC	NS
Polypropylene Glycol (25322-69-4)	NS	ES	NS	NS	NS	ES	NL	ES	HC	NL
1,2 Propylene Glycol (57-55-6)	NL	NS	NS	NL	NL	LC	NL	NL	NL	ES
Low-priority Chemicals										
Petroleum Lube Oil (64742-58-1)	NS	NS	NS	NS	NS	NS	NS	HC	HC	NS
Polyethylene (9002-88-4)	IE	NS	NS	NS	NS	NS	NS	NS	NS	NS
Polyvinyl Alcohol (9002-89-5)	IE	NS	NS	NS	NS	NS	NS	NS	NS	NS

See Table B-1. for more details.

[#]"Conclusions available" relate to language used by authoritative sources as follows: inadequate evidence = nonclassifiable (cancer); limited animal evidence = nonclassifiable (cancer); lower confidence or severity = possibly (cancer), suspected (noncancer), irritant category with other conflicting data, conflicting sensitizing data; moderate confidence or severity = probably (cancer), presumed (noncancer), animal data-derived risk estimate value, category 3 (irritant), category 1B (sensitizer); higher confidence or severity = known (cancer, noncancer), human data-derived risk estimate value, category 1 and 2 (irritant), category 1A (sensitizer).

Figure 2. Summary of Findings from Phase 1 Authoritative Source[a] Reviews for Five PFAS Chemicals

No Conclusion		Conclusion Available[b]					
NS	ES	NL	IE	LA	LC	MC	HC
No or Few Studies	Evidence Suggestive	Not Likely Risk	Inadequate Evidence	Limited Animal Evidence	Lower Confidence or Severity	Moderate Confidence or Severity	Higher Confidence or Severity

Chemical (CASRN)	Cancer	Noncancer					Irritants/Sensitizers			
		Nervous	Immune	Developmental	Reproductive	Other Organs	Skin Sensitization	Skin Irritation	Eye Irritation	Respiratory Irritation
6:2 FTSHA (88992-45-4)	NS	NS	NS	MC	MC	NS	LC	NL	HC	NS
6:2 FTSAS (88992-47-6)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
6:2 FTSA (27619-97-2)	NS	NS	NS	NL	NL	NS	NL	HC	HC	NS
6:2 FTSA-PrB (34455-29-3)	NS	NS	NS	NS	NS	NS	NL	NL	ES	NS
6:2 FTNO (80475-32-7)	NS	NL	NS	NL	NL	NS	NL	NL	NL	NS

See Table B-2 for more details.
PFAS = per- and polyfluoroalkyl substances.
[a]A list of authoritative sources is available in Box 1.
[b]"Conclusions available" relate to language used by authoritative sources as follows: inadequate evidence = nonclassifiable (cancer); limited animal evidence = nonclassifiable (cancer); lower confidence or severity = possibly (cancer), suspected (noncancer), irritant category with other conflicting data, conflicting sensitizing data; moderate confidence or severity = probably (cancer), presumed (noncancer), animal data-derived risk estimate value, category 3 (irritant), category 1B (sensitizer); higher confidence or severity = known (cancer, noncancer), human data-derived risk estimate value, category 1 and 2 (irritant), category 1A (sensitizer).

Irritation

Testing or health characterization of chemicals was the most complete for acute effects such as irritation or sensitization (see Figure 3). Most chemicals were classified as causing skin (10 of 15 chemicals) or eye (11 of 15 chemicals) irritation, including all the higher-priority chemicals, two moderate-priority chemicals (dipropylene glycol for both outcomes and polypropylene glycol for eye), and one low-priority chemical. The reviews concluded that diethylene glycol was not a skin or eye irritant, and 1,2 propylene glycol was not an eye irritant. No other conclusions were identified for the other moderate- and low-priority chemicals. Approximately half (7 of 15 chemicals) cause respiratory irritation, including seven higher-priority chemicals. Polypropylene glycol was not considered a respiratory irritant. No authorative conclusions were found for benzene, three of the four moderate-priority chemicals, and all three low-priority chemicals. However, the reviews reported individual study findings for benzene, diethylene glycol, and 1, 2 propylene glycol. Adverse respiratory effects or irritation from multiple chemicals are consistent with reported symptoms (e.g., running nose; congestion; coughing; burning nose, throat, or eyes; irritation) from the affected community and first responders in CDC's ACE survey.

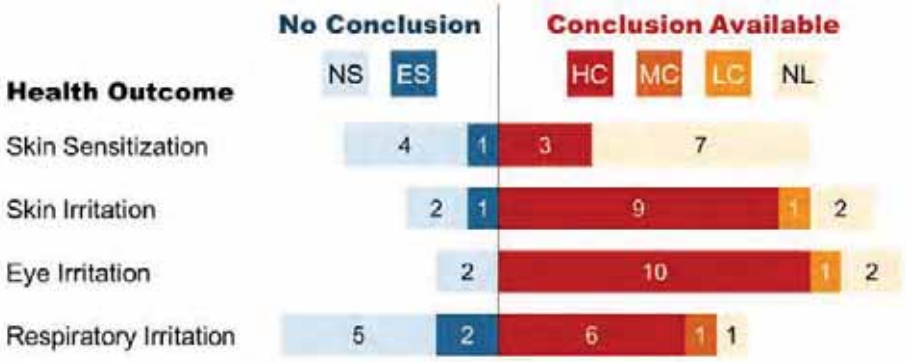
For PFAS, one chemical (6:2 FTSA) was classified for corrosive effects to the skin, whereas three chemicals (6:2 FTSHA, 6:2 FTSA-PrB, and 6:2 FTNO) did not have irritating effects to the skin in studies reported in Phase 1 sources. Conclusions for eye irritation were available for two chemicals (6:2 FTSHA and 6:2 FTSA); some irritation was reported following exposure to 6:2 FTSA-PrB in rabbits, and no eye irritation was predicted for 6:2 FTNO based on in vitro assay results. Data were not available for categorizing irritating effects to the respiratory system following PFAS exposures.

Skin Sensitization

While some authoritative sources discussed skin sensitization in the context of immune effects, skin sensitization was characterized as a separate outcome category in this review. Three higher-priority chemicals were categorized for skin sensitizing effects (butyl acrylate, 2-ethylhexyl acrylate, and vinyl chloride). ECHA reported sensitizing properties for acrolein, another higher-priority chemical, but did not categorize it for sensitization. Little or no indication of skin sensitization was reported for seven chemicals (2-butoxyethanol, benzene, hydrogen chloride, diethylene glycol, dipropylene glycol, polypropylene glycol, and 1,2 propylene glycol). No or unclear conclusions were available for the remaining chemicals.

Among the five PFAS, authoritative sources reported little or no concern for skin sensitization following exposure to three chemicals (6:2 FTSA, 6:2 FTSA-PrB, and 6:2 FTNO). Mixed results were reported from animal and in vitro studies for one chemical (6:2 FTSHA). Skin sensitization data were not available for the remaining PFAS (6:2 FTSAS).

Figure 3. Phase 1 Irritant and Sensitizer Findings for 15 East Palestine Chemicals of Interest



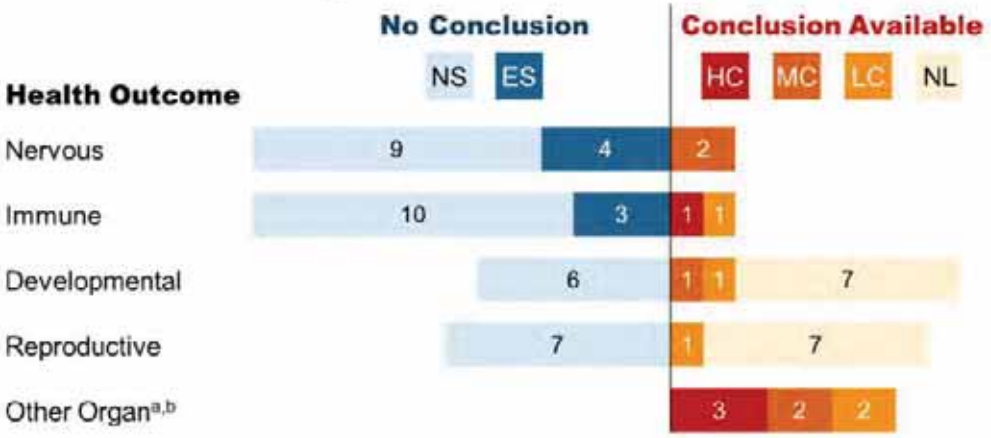
NS = no or few studies; ES = evidence suggestive; NL = not likely to be irritating or sensitizing; LC = lower confidence: irritant category with other conflicting data; MC = moderate confidence or severity: animal data-derived risk estimate value, category 3 (irritant), category 1B (sensitizer); HC = higher confidence or severity: human data-derived risk estimate value, category 1 and 2 (irritant), category 1A (sensitizer).

Other Noncancer Outcomes

Authoritative conclusions for reproductive and developmental toxicities were available for approximately half of all chemicals (see Figure 4 for noncancer outcome findings). Of the eight higher-priority chemicals, two (benzene and vinyl chloride) may be linked to developmental effects. CalEPA Proposition 65 lists benzene as a chemical that can cause developmental and reproductive effects; other reviews agreed with the developmental effects conclusions (particularly for developmental hematotoxicity) but stated that the evidence for reproductive effects was limited. Although positive associations have been observed for 2-butoxyethanol exposure and adverse reproductive (e.g., effects to reproductive organs or in pregant animals) and developmental outcomes, these effects occurred at high doses or at doses causing maternal toxicity. As a result, several authoritative sources concluded that the chemical is not significantly toxic to reproduction or the developing fetus. ECHA concluded there was little concern for the reproductive and developmental effects from exposure to three other higher-priority chemicals (acrolein, butyl acrylate, and 2-ethylhexyl acrylate) and three moderate-priority chemicals (diethylene glycol, dipropylene glycol, and 1,2 propylene glycol). No or unclear conclusions for both reproductive and developmental effects are available for the remaining high-priority chemicals: hydrogen chloride and phosgene gas. ECHA classified one of the five PFAS (6:2 FTSHA) as a presumed toxicant to fertility and development. Three of the remaining PFAS did not display either reproductive (6:2 FTSA and 6:2 FTNO) or developmental (6:2 FTSA, 6:2 FTSA-PrB, and 6:2 FTNO) toxicity. No conclusions were available for the remaining PFAS (6:2 FTSAS).

Health outcome conclusions were sparse for neurotoxicity (2 of 15 chemicals) and immunotoxicity (2 of 15 chemicals). Vinyl chloride was deemed a presumed neurotoxicant and a suspected immunotoxicant, and benzene was associated with both neurotoxicity in workers exposed to high doses and adverse immune effects. Some authoritative sources noted that some immunotoxicity outcomes associated with benzene exposure may result from hematotoxicity or may occur at levels like those inducing hematotoxicity.

Figure 4. Phase 1 Noncancer Findings for 15 East Palestine Chemicals of Interest



NS = no or few studies; ES = evidence suggestive; NL = not likely risk; LC = lower confidence: suspected; MC = moderate confidence: presumed, animal data-derived risk estimate value; HC = higher confidence: known, human data-derived risk estimate value.
[a]The "Other Organ" category includes double counts for one chemical (2-butoxyethanol), wherein different conclusions (e.g., lower confidence and higher confidence) were available for different organ systems.
[b]Information on "Other Organ" systems was not reported consistently across authoritative reviews. "No conclusion" determinations for the Other Organ category are not included in this figure due to the heterogeneous reporting.

Based on identifed research gaps for the higher-priority chemicals, we selected the following chemical-outcome pairs for Phase 2 activities (see Methods).

Neurotoxicity: Acrolein, 2-ethylhexyl acrylate, butyl acrylate, 2-butoxyethanol

Immunotoxicity: Butyl acrylate, 2-butoxyethanol

Hepatotoxicity: Butyl acrylate

Cancer Outcomes

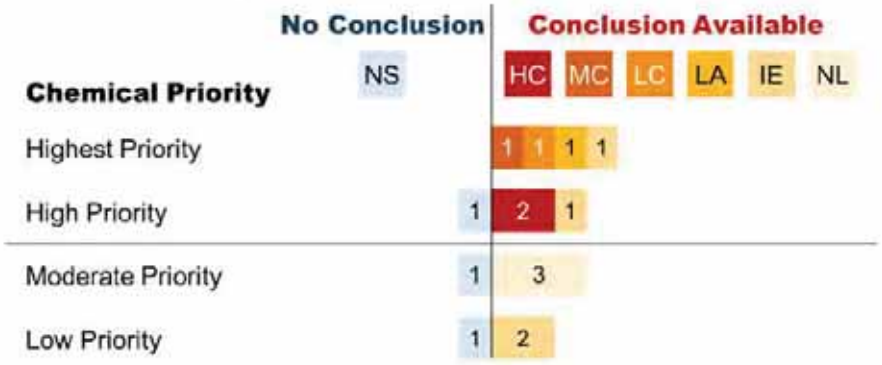
Cancer conclusions were available for approximately two-thirds (12 of 15) of the chemicals (see Figure 5). Of the eight higher-priority chemicals, five can cause cancer in humans or experimental animals: benzene and vinyl chloride are "known human carcinogens" (IARC, NTP Report on Carcinogens), acrolein is "probably carcinogenic to humans" based on mechanistic and animal cancer data (IARC 2A), 2-ethylhexyl acrylate is "possibly carcinogenic to humans" (IARC 2B) based on sufficient evidence from studies in experimental animals, and 2-butoxyethanol induces tumors (hemangiosarcoma of the liver in male mice). IARC considered the evidence limited in experimental animals for 2-butoxyethanol and, thus, not classifiable as to its carcinogenicity (Group 3). Butyl acrylate and hydrogen chloride are also classified as Group 3 by IARC based on inadequate evidence from experimental animal and human studies. No conclusions were available for phosgene gas. The other moderate- and low-priority chemicals were either not likely to cause cancer or had no identifiable conclusions. Cancer types were available for the known human carcinogens: benzene causes acute myeloid leukemia and other acute nonlymphocytic leukemia and may cause other lymphohematopoietic cancers (chronic myeloid leukemia, chronic lymphocytic leukemia, childhood leukemia, non-Hodgkin lymphoma, and multiple myeloma) and lung cancer; vinyl chloride causes angiosarcomas in the liver.

Data on cancer effects were not available from authoritative sources for the five PFAS. Based on these research gaps, we identified the following chemicals for Phase 2 searches for cancer outcomes:

Human cancer studies: Acrolein, 2-ethylhexyl acrylate, 2-butoxyethnanol

Human and animal cancer studies: Butyl acrylate

Figure 5. Phase 1 Cancer Findings for 15 East Palestine Chemicals of Interest



NS = no or few studies; NL = not likely risk; IE = inadequate evidence: nonclassifiable; LA = limited animal evidence: nonclassifiable; LC = lower confidence: possibly carcinogenic to humans; MC = moderate confidence: probably carcinogenic to humans, animal data-derived risk estimate value; HC = higher confidence: known human carcinogen, human data-derived risk estimate value.

Phase 2

Overview

Results from the 13 targeted searches and screenings conducted during Phase 2 are available in Table 1. For six of the 13 searches (acrolein-cancer, 2-ethylhexyl acrylate-cancer, 2-ethylhexyl acrylate-nervous, butyl acrylate-hepatic, butyl acrylate-nervous, 6:2 FTNO-any health outcome), no relevant results were identified during title-abstract and/or full-text screening.

At least one PECO-relevant reference was identified for each of the remaining seven searches (acrolein-nervous [n = 8], 2-butoxyethanol-cancer [n = 1], 2-butoxyethanol-immune [n = 10], 2-butoxyethanol-

nervous [PECO relevant n = 1; PECO supplemental n = 3], butyl acrylate-cancer [n = 1], butyl acrylate-immune [PECO relevant n = 2; PECO supplemental n = 3], and 6:2 FTSA-any health outcome [n = 2]). Although five PECO-relevant studies were identified for butyl-acrylate-immune, all five reported on skin sensitization findings only. As skin sensitization data were considered separately from immune data during Phase 1, the five studies were not considered for further analysis during Phase 2.

For the remaining six chemical × health outcome pairings, PECO-relevant studies were compared with the list of studies included in authoritative source reports identified during Phase 1. New studies were identified for each chemical × health outcome pair. For chemical × health outcome pairings with at least one new study (acrolein-nervous, 2-butoxyethanol-cancer, 2-butoxyethanol-immune, 2-butoxyethanol-nervous, and 6:2 FTSA-any health outcome), we examined and summarized all studies identified during Phase 2, alongside some findings from authoritative source reports in Phase 1. Findings for each chemical × health outcome pair are summarized by endpoint in the text (acrolein-nervous; 2-butoxyethanol cancer; and 6:2 FTSA-any health outcome) and Table 2 (2-butoxyethanol-immune) and Table 3 (2-butoxyethanol-nervous) below.

Table 1. Overview of Phase 2 Results

Chemical-Outcome Category	Phase 1 Authoritative Source Conclusions	Search Limits, Date Completed	Results (N)	PECO-relevant Studies (N)	Phase 2 New Studies (N)	Evidence Gap
Acrolein-Cancer	Probably carcinogenic to humans (Group 2A); Inadequate human evidence	Studies published 2020–present, June 22, 2023	183	0	0	Research gap remains (human cancer studies)
Acrolein-Nervous	No conclusions: Suggestive evidence from Causaly	No date limit, June 20, 2023	226	8 reviews	7 reviews	Systematic review may be warranted
2-butoxyethanol-Cancer	Not classifiable (Group 3); Limited evidence in experimental animals	No date limit, July 6, 2023	35	1 human	1 human	Research gap remains
2-butoxyethanol-Immune	No conclusions: Suggestive evidence	No date limit, July 5, 2023	151	1 human 9 animal	1 human 1 animal	Additional studies with focus on functional immunotoxicity are needed
2-butoxyethanol-Nervous	No conclusions: Suggestive evidence	No date limit, July 5, 2023	112	1 animal 3 supplemental	1 animal	Additional studies designed to assess neurological effects are needed
Butyl acrylate-Cancer	Not classifiable (Group 3); Inadequate human and animal evidence	No date limit, July 6, 2023	65	1 animal	0	Research gap remains
Butyl acrylate-Hepatic	No conclusion: Suggestive evidence	No date limit, July 7, 2023	19	0	0	Research gap remains
Butyl acrylate-Immune	No conclusions: Few studies; Skin sensitization: Category 1	No date limit, July 5, 2023	92	2 animal[a] 3 supplemental[a]	0	Research gap remains (immune endpoints other than skin sensitization)
Butyl acrylate-Nervous	No conclusions: Few studies	No date limit, July 5, 2023	97	0	0	Research gap remains
2-ethylhexyl acrylate-Cancer	Possibly carcinogenic (Group 2B); Inadequate human evidence	Studies published 2019–present, June 20, 2023	6	0	0	Research gap remains (human cancer studies)
2-ethylhexyl acrylate-Nervous	No conclusions: Few studies	No date limit, June 23, 2023	9	0	0	Research gap remains

Chemical-Outcome Category	Phase 1 Authoritative Source Conclusions	Search Limits, Date Completed	Results (N)	PECO-relevant Studies (N)	Phase 2 New Studies (N)	Evidence Gap
6:2 FTSA-Any	Skin irritation: Category 1B; Eye irritation: Category 1; No effects for developmental, reproductive outcomes or skin sensitization in animal studies. No other conclusions based on limited evidence in experimental animals.	Studies published 2020–present, August 10, 2023	45	1 human 1 animal	1 human 1 animal	Research gaps remain
6:2 FTNO-Any	No effects observed on nervous, reproductive, developmental, hematologic, dermal, or ocular outcomes in animal studies.	No date limit, August 10, 2023	0	0	0	Research gaps remain

Bold chemical x outcome pairings are discussed in more detail in the following sections.
PECO = Population, Exposure, Comparator, and Outcome.
[a]All studies on skin sensitization.

Selected Chemical-Outcome: Acrolein-Nervous System

Four authoritative reviews—(ATSDR 2007a) (12 studies), (ECB 2001) (1 study), (USEPA 2003b) (1 study), and (OEHHA 2014) (4 studies)—discussed findings from studies examining acrolein exposures and neurological effects, although none made hazard conclusions. Additionally, outputs from Causaly identified reviews and primary articles that discussed potential associations between acrolein levels and various neurological outcomes, including Alzheimer's disease, Parkinson's disease, and strokes.

Our scoping search to find published reviews on neurological outcomes identified eight reviews discussing effects associated with acrolein exposure in humans and animals (Alarie 1973; Chang et al. 2022; Igarashi et al. 2018; 2020; Moghe et al. 2015; Muguruma et al. 2020; Park and Igarashi 2013; Singh et al. 2010). One review was discussed in ATSDR, 2007 (Alarie 1973), but the remaining four were not included in any authoritative sources. The four authoritative reports also included 14 primary studies in experimental animals—reporting effects related to neurotransmitter (neuropeptide) depletion, increased brain weight, inflammatory responses, loss of nerve tissue, and nonspecific histopathological effects (in inhalation studies)—and one primary study in humans—reporting increased acrolein levels in the brains of Alzheimer's patients compared to control subjects at autopsy. Most studies discussed in the ATSDR Toxicological Profile examined general toxicity in experimental animals and were not designed to measure neurotoxicity. A crosswalk of studies discussed in authoritative reviews and identified during Phase 2 is available in Table B-3.

Detailed results from the eight reviews identified in our scoping search are provided in the text below. As our search identified reviews only, a summary table is not provided. Importantly, exposure to acrolein can occur both exogenously and endogenously, as the chemical is a byproduct of lipid peroxidation initiated by oxidative stress. In the eight identified reviews, acrolein is often used as a biomarker for oxidative stress and lipid peroxidation. Therefore, it was often unclear whether neurological effects are related specifically to acrolein or to oxidative stress. The review findings should be considered in this context.

Three other reviews identified during Phase 2 reported on the mechanistic effects of acrolein in nervous tissues, although mechanistic evidence was not the primary focus of our scoping activities (Arlt et al. 2002; Iqubal et al. 2020; LoPachin et al. 2008). Acrolein was discussed as a highly toxic product of lipid peroxidation that can cross the blood-brain barrier (Iqubal et al. 2020). In vitro and in vivo studies of neuroinflammation and neurodegeneration and acrolein's role in the development of Alzheimer's Disease, Parkinson's Disease, and spinal cord injury were cited as evidence of its neurotoxic potential. Other reported mechanistic evidence suggests that acrolein induces demyelination of nerves—which impacts nerve conduction—neuronal apoptosis, neurotransmitter alterations, and protein adduct formation. Other reviews reported inhibition of glutamate and glucose uptake in acrolein-exposed neuronal cell cultures (Arlt et al. 2002) and disruption of nerve terminals and subsequent potential for synaptic damage in in vitro studies (LoPachin et al. 2008). These reviews suggest that acrolein, whether endogenous or exogenous, has the potential for neurotoxic effects.

Reviews of human and animal studies discussed the association between acrolein and strokes of varying severity (Chang et al. 2022; Igarashi et al. 2020; Moghe et al. 2015; Muguruma et al. 2020); however, the discussion of acrolein's role differed across reviews. Some reviews assessed acrolein's role in development of stroke or brain infarction, whereas others examined acrolein as a byproduct of the oxidative stress induced by stroke or brain infarction and its potential to cause additional neurological damage. Acrolein may be produced endogenously via lipid peroxidation during ischemic stroke (Chang et al. 2022), and increased endogenous acrolein production has been reported in connection with both severe strokes and silent brain infarctions (Muguruma et al. 2020). A mechanistic study summarized in Muguruma et al. (2020) suggested that acrolein elicited a cycling of oxidative stress, resulting in stroke-related neuronal damage, and is a suspected driver of neuronal damage in stroke patients. Plasma levels of protein-conjugated acrolein (along with acrolein-producing enzymes) were shown to be appropriate biomarkers for human stroke (Igarashi et al. 2018; 2020; Moghe et al. 2015; Park and Igarashi 2013) and silent brain infarctions (Igarashi et al. 2020). Multiple human studies have found dysregulated acrolein

metabolism in stroke patients (Chang et al. 2022).

Findings from reviews of animal studies further support an association between acrolein and stroke, although it was unclear whether animals were dosed in studies cited in the reviews or whether effects were associated with endogenous acrolein. A review of animal studies reported an association between decreasing levels of acrolein and decreased infarction size (Chang et al. 2022). A study in mice indicated that, during brain infarction, acrolein is "more strongly involved" in cell damage than reactive oxygen species (Igarashi et al. 2020). Other reviews reported increased levels of acrolein at the site of brain infarction in mouse models (Igarashi et al. 2018; Park and Igarashi 2013). Neuronal damage was also reported in a review of animal studies, including acrolein-induced neuronal damage in pigs and rats, although some studies reported effects of endogenous acrolein only and should be considered accordingly (Moghe et al. 2015). In an in vitro study, acrolein induced mitochondrial dysfunction leading to neuronal death in HT22 mouse hippocampal cells (Moghe et al. 2015).

Other neurological outcomes have also been considered for their association with acrolein exposure. In humans, significantly increased levels of acrolein were reported in the brains of patients with mild cognitive impairment (Igarashi et al. 2020; Muguruma et al. 2020; Singh et al. 2010) and cognitive impairment that had progressed to Alzheimer's disease compared to control subjects (Chang et al. 2022; Igarashi et al. 2020; Muguruma et al. 2020; Singh et al. 2010). For cases of Parkinson's disease, both human and animal studies reported that acrolein exposure leads to damage of the substantia nigra (Chang et al. 2022). In a mouse model of multiple sclerosis, acrolein was found to be a critical pathological factor in development of autoimmune encephalomyelitis (Chang et al. 2022). Finally, in a review of animals exposed to acrolein via inhalation, alterations in reflex reactions and sensory irritation were reported in guinea pigs. Alterations were a result of pulmonary nerve ending stimulation from the chemical. Decreased respiratory rates were also reported in guinea pigs and in rabbits (Alarie 1973).

Evidence Gap Summary: *A systematic review* critically assessing the body of evidence may be warranted of human, animal, and mechanistic studies, with a particular focus on effects from exogenous acrolein exposures.

Selected Chemical-Outcome: 2-Butoxyethanol-Cancer

IARC (2006) concluded that 2-butyoxyethanol was not classifiable based on its carcinogenicity to humans due to limited evidence from studies in experimental animals and inadequate evidence from studies in humans. One human study with limited information on 2-butoxyethanol exposure was identified. The limited evidence of carcinogenicity in experimental animals was from a study of 2-butoxyethanol inhalation in rats and mice published in NTP Technical Report 484 (NTP TR-484) (2000). Additional studies published after the IARC Monograph were not identified for the other two authoritative reviews (EPA IRIS (2010) and OEHHA (2018)). In mice, NTP (2000) concluded there was some evidence of carcinogenicity in males based on liver hemangiosarcomas and in females based on forestomach squamous cell papilloma or carcinoma (mainly papilloma). For rats, there was equivocal evidence of carcinogenicity in females based on benign and malignant pheochromocytoma (mostly benign) of the adrenal medulla and no evidence of carcinogenicity in males.

Our scoping activities to find cancer studies in the literature identified one primary article published after the authoritative reviews that described cancer effects associated with 2-butoxyethanol exposure in humans (Rodrigues et al. 2020). Rodrigues et al. (2020), an occupational nested case-control study of workers at three semiconductor and storage device manufacturing facilities, evaluated the association between exposure to 31 known or possible carcinogens, including 2-butoxyethanol, and central nervous system (CNS) cancers. The study reported significant exposure-response associations ($p_{trend} < 0.01$) with increased odds ratios (ORs) for CNS cancer incidence in all quartiles (vs. Quartile 1) at two of the three module manufacturing work sites assessed; ORs were <1 at the third site. Statistically significant positive trends were reported for several chemicals that were present in the module manufacturing work sites in addition to 2-butoxyethanol.

Evidence Gap Summary: A *research gap remains* for additional primary studies of the carcinogenicity of

2-butoxyethanol, particularly for studies of effects in human populations.

Selected Chemical-Outcome: 2-Butoxyethanol-Immune

Three authoritative reviews – (ATSDR 1998) (24 studies), (USEPA 2010) (5 studies), and (OEHHA 2018) (5 studies) – discussed findings from studies examining 2-butoxyethanol exposures and immune effects, although none made hazard conclusions. Despite the lack of hazard conclusions, each review provided summaries of immunological findings from several studies in animals and humans. Our scoping activities to find immunological studies in the published literature identified 10 discussing immune-related outcomes associated with 2-butoxyethanol exposure, including one primary article in a human population (Song et al. 2017) and nine primary articles in experimental rodents (rats and mice) (Chereshnev et al. 2014; Dodd et al. 1983; Exon et al. 1991; Ghanayem et al. 1987a; Grant et al. 1985; Krasavage 1986; Singh et al. 2001; Smialowicz et al. 1992; Starek et al. 2008). Two of these studies were not included in the collective authoritative source reports (Song et al. 2017; Starek et al. 2008). Additional animal toxicology studies summarized in ATSDR (1998) identified immunological effects in studies designed to assess general toxicity (and thus, not all were identified by our immune-targeted literature searches). These studies largely reported effects in lymphoreticular organs (e.g., thymus weight changes, thymus histopathology), whereas reviews from EPA IRIS (2010) and OEHHA (2023d) were primarily of studies designed to evaluate immunotoxicity and found evidence of immunomodulatory effects (see study summaries in Table 2). A crosswalk of studies discussed in authoritative reviews and identified during Phase 2 is available in Table B-4.

We reviewed studies identified in our scoping activities and the summaries of studies from authoritative reviews (that were not identified in our literature searches). In their discussion of immunotoxic effects, ATSDR (1998) discussed immune and lymphoreticular effects separately and noted that some impacts to lymphoreticular organs can be attributed to hematotoxicity rather than immunotoxicity (noting that there is overlap between the two, as leukocytes can be classified as part of both systems). These studies were not considered in this report's summary of immune effects. Additionally, we did not include four studies from the reports that examined skin sensitization in humans (CMA 1993; Greenspan et al. 1995), guinea pigs (Zissu 1995), and mice (Singh et al. 2002) because our review of authoritative sources discussed skin sensitization as a separate health outcome category (see Figure 1). Detailed summaries from 16 studies reporting immunotoxicity effects (functional and observational findings) are available in Table 2.

Evidence Gap Summary: *Additional studies focusing on functional immunotoxicity* are needed to provide more specific information on the direct effects of 2-butoxyethanol on the immune system. Available studies may not be adequate for an SR.

Table 2. Detailed Summary of 2-Butoxyethanol Immune Studies Identified during Phase 2

Endpoint, Identified Studies	Summary of Findings	Endpoint Summary
	Functional Immune Findings	
Antibody Response (Functional Assay) 3 *primary* articles in animals (Exon et al. 1991; Singh et al. 2001; Smialowicz et al. 1992)	• No significant findings in male and female rats exposed via drinking water for 21 days at doses ranging from 1,600 to 6,000 ppm (Exon et al. 1991) or in male rats dosed by oral gavage for 2 days after immunization at doses ranging from 50 to 100 mg/kg/day (Smialowicz et al. 1992). The authors attributed signficant findings at 200 mg/kg/day to hematotoxicity and mortality (Smialowicz et al. 1992). • No significant effects to IgM plaque-forming cell response to sheep red blood cells in female mice exposed topically for 4 days at doses ranging from 100 to 1,500 mg/kg/day (Singh et al. 2001).	No significant findings in two studies of rats at nontoxic doses and in one study of female mice.
Autoimmune Response	• A study of male rats following a single intraperitoneal injection of 20 mg/kg-bw reported significantly increased in vitro agglutination to the rat's own red blood cells collected prior to	Increased autoimmune response in one study of male rats that also

Endpoint, Identified Studies	Summary of Findings	Endpoint Summary
1 *primary* article in animals (Chereshnev et al. 2014)	study initiation, suggestive of autoimmune response (Chereshnev et al. 2014). The study also reported histopathological changes in the thymus, indicative of organ stress response (see Observational Findings below).	reported histopathological thymus effects.
Natural Killer (NK) Cell Activity 2 *primary* articles in animals (Exon et al. 1991; Singh et al. 2001)	• Significant increase in NK cytotoxic responses in male and female rats exposed via drinking water for 21 days at doses ranging from 1,600 to 6,000 ppm (Exon et al. 1991). • No effect on NK cytotoxic activity in female mice exposed topically for 4 days at doses ranging from 100 to 1,500 mg/kg/day (Singh et al. 2001).	Increased responses reported in one rat study; no change in one mouse study exposed to lower doses.
Delayed-type Hypersensitivity (DTH) Response 1 *primary* article in animals (Exon et al. 1991)	• No significant effects on the DTH response in male and female rats exposed via drinking water for 21 days at doses ranging from 1,600 to 6,000 ppm (Exon et al. 1991).	No significant findings in one study in rats.
Cytotoxic T Lymphocyte (CTL) Activity 1 *primary* article in animals (Singh et al. 2001)	• No signficant response to cytotoxic T-cell response (primarily CD8+ cells) (Singh et al. 2001).	No significant response in one study in mice.
Mixed Lymphocyte Response (MLR) 1 *primary* article in animals (Singh et al. 2001)	• Signficant reduction of the MLR to allogenic antigen in female mice exposed topically for 4 days at doses ranging from 100 to 1,500 mg/kg/day (Singh et al. 2001).	Reduced MLR in one study in mice.
Nonspecific Mitogenic Response (Lymphoproliferative Assays) 1 *primary* article in animals (Singh et al. 2001)	• B-cell mitogens: No significant effects to splenic B-cell lymphoproliferate response to LPS in female mice exposed topically for 4 days at doses ranging from 100 to 1,500 mg/kg/day (Singh et al. 2001). • T-cell mitogens: Significant reduction of lymphoproliferative response to splenic T-cell lymphoproliferate response to Con a in female mice exposed topically for 4 days at doses ranging from 100 to 1,500 mg/kg/day (Singh et al. 2001).	Reduced lymphoproliferative response results in T-cell assays in one study in mice. No effects in B-cell assays.
Observational Immune Findings		
Cytokines 1 *primary* article in animals (Exon et al. 1991)	• No significant findings in interleukin-2 (IL-2) or interferon (IFN) production in male and female rats exposed via drinking water for 21 days at doses ranging from 1,600 to 6,000 ppm (Exon et al. 1991).	Histopathology of the thymus was reported in one study that also found increased autoimmune response in rats. Other observational findings were largely mixed and lacked consistency, as studies reporting effects varied in design, route of exposure, and
Immune Organ Histopathology 9 *primary* articles in animals (CMA 1983; Chereshnev et al. 2014; Duprat and Gradiski 1979; Exon et al. 1991; Grant et al. 1985; Krasavage 1986;	• One study reporting autoimmune response following exposure also observed involution of the thymus (Chereshnev et al. 2014). Another study observed changes in thymic cellularity, including transient lymphocyte depletion in the cortex and increased lymphocytes in the medulla (Grant et al. 1985). • Two studies reported histopathological changes in the spleen, including a significant decrease in relative volume of white pulp (Chereshnev et al. 2014) and white atrophic pulp after death (Duprat and Gradiski 1979).	

Endpoint, Identified Studies	Summary of Findings	Endpoint Summary
Nachreiner 1994; NTP 1993; Shepard 1994)	• No histopathological changes were reported in the thymus or lymph nodes in other studies of rats, guinea pigs, mice, and rabbits of various designs. Most studies provided observational data only and did not include functional measures.	species. The study heterogeneity limits the ability to draw conclusions about observational immune findings.
Immune Organ Weight 6 *primary* articles in animals (CMA 1983; Exon et al. 1991; Grant et al. 1985; NTP 1993; NTP 2000; Singh et al. 2001)	• Mixed results were reported for relative and absolute thymus weights across studies of various designs, exposure routes, and measurement timings.	
White Blood Cell Counts and Differentials 1 *primary* article in humans (Song et al. 2017) 7 *primary* articles in animals (Dodd et al. 1983; Ghanayem et al. 1987a; Grant et al. 1985; Krasavage 1986; NTP 1993; NTP 2000; Starek et al. 2008)	• Mixed results were reported for white blood cell changes, including for total leukocyte counts and differentials, with studies reporting significant increases, significant decreases, and no significant changes across a variety of study designs, exposure routes, and measurement timings. • Lymphocyte counts were mixed across one study in humans and six studies in animals. Some studies of longer duration reported significant findings (increases and decreases) at earlier timepoints that were not reported at later timepoints. • Of studies reporting neutrophil counts, several reported significantly increased counts at various time points that were not observed at later time points. Other studies reported decreases or no change in counts.	

Selected Chemical-Outcome: 2-Butoxyethanol-Nervous System

Three authoritative reviews—(ATSDR 1998) (24 studies), (USEPA 2010) (9 studies), and (OEHHA 2018) (5 studies)—discussed studies of neurological effects following exposure to 2-butoxyethanol. ATSDR's review of the association between exposure to 2-butyoxyethanol and neurological effects included many general toxicology studies of animals exposed by oral, dermal, and inhalation routes and several case reports. Reviews from EPA and OEHHA were limited to case-reports. Our scoping activities to find neurological studies in the published literature identified one primary article in rats that was not included in any authoritative reviews (Nyska et al. 1999) and three human case reports included in the reviews (Burkhart and Donovan 1998; Dean and Krenzelok 1992; Osterhoudt 2002).

Below, we review the combined body of relevant literature (human and animal studies), which consists of animal evidence reported by ATSDR, an additional animal study identified in our scoping review, and the collective case reports/series identified in our scoping review and discussed in authoritative reviews.

ATSDR (1998) concluded that exposure to high doses in experimental animals can cause nervous system effects (e.g., physical weakness, unsteadiness, drowsiness, prostration, abnormal eye movement, convulsions). Studies also reported clinical observations prior to death (e.g., convulsions, nystagmus, moderate to marked inactivity, ataxia). While ATSDR classifies many of these as clinical signs of neurotoxicity, these could also be attributed to other causes. Thus, we did not include 14 animal studies reporting on these symptoms and clinical observations. Brain weight findings were also not included in this review, as ATSDR reported results from only two studies, and it was unclear whether this endpoint was measured in other general toxicity studies. Other observed effects in case reports and animal studies that may be more reflective of impacts to neurological function are included, such as cases of coma following exposure, severe CNS depression, and effects related to the motor and vestibular systems (e.g., impacts to coordination, loss of equilibrium), sensory systems (e.g., disturbed taste), and neurological histopathology (e.g., histopathological changes to the brain and nerves). A crosswalk of

studies discussed in our report from authoritative reviews and identified during Phase 2 is available in Table B-5.

Detailed summaries of neurotoxicity findings from 17 studies (8 case reports/series, 9 primary studies) are available in Table 3.

Evidence Gap Summary: *Additional studies are needed* including human epidemiological and additional animal studies specifically designed to assess neurological effects following exposure. Inadequate database for an SR.

Table 3. Detailed Summary of 2-Butoxyethanol Nervous Studies Identified during Phase 2

Endpoint, Identified Studies	Summary of Findings	Endpoint Summary
	Animal Studies	
Brain and Nerve Histopathology 5 *primary* articles in animals (CMA 1983; Dodd et al. 1983; Eastman Kodak 1983; Krasavage 1986; NTP 1993)	• No lesions or histopathological changes were noted in the brains or nervous tissue of rats, mice, or rabbits exposed via oral, inhalation, and dermal routes (CMA 1983; Dodd et al. 1983; Eastman Kodak 1983; Krasavage 1986; NTP 1993).	No histopathological changes identified.
Motor and Vestibular Deficits 3 *primary* articles in animals (Dodd et al. 1983; Dow 1986; Wier et al. 1987)	• Loss of coordination was observed in male and female rats after inhalation exposure to 523 and 867 ppm, respectively, for 4 hours (Dodd et al. 1983). • Male albino rabbits showed loss of equilibrium and poor coordination from inhalation exposure for 7 hours/day for 1–2 days at ~400 ppm (Dow 1986). • Pregnant mice exposed via gavage at ≥1,500 mg/kg/day experienced lethargy and failure to right (Wier et al. 1987).	Signs of coordination and equilibrium loss in three animal studies.
Sensory Impacts 1 *primary* article in animals (Nyska et al. 1999)	• Photoreceptor degeneration observed in 5/8 female rats following daily gavage exposure to 250 mg/kg-bw for 3 days (Nyska et al. 1999).	Photoreceptor effects in one animal study.
	Human Studies	
Severe Nervous System Depression (Including Coma) 5 *case reports* in humans (Bauer et al. 1992; Burkhart and Donovan 1998; Dean and Krenzelok 1992; Gijsenbergh et al. 1989; Litovitz et al. 1991; Rambourg-Schepens et al. 1988).	• Comas were observed in males and females ranging from 19 to 87 years old after ingestion of 2-butoxyethanol, largely from household cleaners, ranging in estimated dose from 391 mg/kg to 650 mg/kg (Bauer et al. 1992; Burkhart and Donovan 1998; Gijsenbergh et al. 1989; Litovitz et al. 1991; Rambourg-Schepens et al. 1988). • After ingesting a household cleaner containing 22% 2-butoxyethanol, an 18-year-old male experienced severe central nervous system depression, although this was not reported after a second ingestion event of the same cleaner (Gualtieri et al. 2003). • Two children (14 months and 2 years old) had no evidence of nervous system depression after ingestion event at estimated doses of 290 and 1,862 mg/kg, respectively (Dean and Krenzelok 1992).	Comas and severe nervous system depression observed in case reports only.
Dysautonomia 2 *case reports* in humans (Burkhart and Donovan 1998; Osterhoudt 2002)	• A 19-year-old male with preexisting neurological conditions showed inhibited reflexes immediately following ingestion (Burkhart and Donovan 1998).	Impacts to reflexes observed in case reports only.

Endpoint, Identified Studies	Summary of Findings	Endpoint Summary
	• A 16-month-old female was unable to open her eyes to voice immediately following ingestion; her gag and withdrawal reflexes were unaffected (Osterhoudt 2002).	
Sensory Impacts 1 *experimental study* in humans (Carpenter et al. 1956)	• Male and female volunteers reported disturbed taste sensation after inhalation at 113 and 195 ppm, respectively, for 4–8 hours in an experimental study (Carpenter et al. 1956).	Taste sensation effects in one human study.
Verbal Function 1 *case report* in humans (Burkhart and Donovan 1998)	• A 19-year-old male with preexisting neurological conditions was unable to speak beyond sounds 2 months after an ingestion event (Burkhart and Donovan 1998).	Verbal function effects in one case report.

Selected Chemical-Outcome: 6:2 FTSA-Any Health Outcome

No reports from authoritative sources that discussed health effects associated with 6:2 FTSA exposure were identified during Phase 1. Our scoping review identified two *primary* studies (one *human* study and one *animal* study) that examined the health effects associated with 6:2 FTSA. Studies assessed reproductive and developmental effects and immune effects.

Reproductive and Developmental Effects

Both studies assessed reproductive and developmental effects associated with 6:2 FTSA exposure (Bohannon et al. 2023; Tian et al. 2023). In humans, a case-control study in Hangzhou, China of 82 preeclamptic pregnant women and 169 healthy control subjects measured 6:2 FTSA in maternal serum prior to delivery (Tian et al. 2023). The study observed no significant associations between maternal serum 6:2 FTSA levels and odds of preeclampsia or odds of low birth weight in infants. A study of male and female white-footed field mice exposed to 6:2 FTSA by oral gavage for 112 days (from 4 weeks premating to ≥4 weeks postmating) observed no associations between 6:2 FTSA exposure and reproductive and fertility endpoints in the exposed mice or developmental endpoints in their offspring. Reproductive and developmental measures included number of mating pairs, number of pregnant animals, total litter loss, proportion of stillbirths, live litter size, total litter size, male sperm parameters, male and female sex hormone levels, and pup weights (Bohannon et al. 2023).

Immune Effects

One primary study in an ecological model assessed the association between 6:2 FTSA exposure and immune endpoints (Bohannon et al. 2023). Male and female white-footed field mice were exposed to 6:2 FTSA by oral gavage for 112 days (from 4 weeks premating to ≥4 weeks postmating). Researchers observed significantly decreased plaque forming cell counts in both males and females, significantly increased spleen weights in males only, and no changes in thymus organ weight or histopathology of the thymus or spleen in either sex (Bohannon et al. 2023). A benchmark dose (BMD) was derived using data for decreased plaque forming cell counts (BMD for males = 4.06 mg/kg/day; for females = 3.72 mg/kg/day). The lower 95% confidence limits (BMDLs) were 2.63 mg/kg/day (males) and 2.26 mg/kg/day (females).

Evidence Gap Summary: A *research gap remains* for primary studies of health hazards associated with 6:2 FTSA exposure in humans and animals. Few studies were identified.

Supplementary Searches

Resources identified from authoritative sources largely discussed effects from dioxins as a class or discussed the health effects associated with 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), a dioxin with well-established human health toxicity that is often referenced as a proxy for the class. Only OEHHA

presented data for the individual dioxin chemicals that were measured in East Palestine. As most resources discussed solely TCDD or dioxins as a class, further exploration of health information from a specific source was not pursued.

The peer-reviewed literature search identified 61 SRs and meta-analyses on dioxins published in the past five years. Based on title-level screening of these 61 references, 17 appeared to report on dioxins and health effects in animals or humans. These reviews were not screened at the title-abstract or full-text levels and were not evaluated for inclusion in our report. No additional searching or screening for literature on dioxins was pursued.

Review Limitations

While we aimed to conduct a robust assessment of the available literature on health effects following exposure to the chemicals of interest, this scoping review has some limitations. First, the heterogeneity of reviews from authoritative sources should be acknowledged. Reports from authoritative sources did not always provide clear interpretations of the available data, and, in some cases, different reports provided conflicting interpretations of largely similar databases, making it difficult to synthesize across some authoritative conclusions. Additionally, some reports (e.g., reports from ECHA) presented hazard data but drew risk-based conclusions, whereas others made hazard conclusions only. Some reviews emphasized animal studies designed to assess toxicities to a specific organ system, such as neurotoxicity or immunotoxicity studies, whereas other authoritative reviews also integrated relevant endpoints from animal studies of general toxicity. Finally, language used to describe hazard and risk is not harmonized across sources. While some provide clear hazard conclusions with specific codified language, others summarize health effects data without obvious conclusive statements. This variable language across sources made it difficult to discern hazard conclusions in some cases.

Second, industrial chemicals, including those in this review, often have substantial publicly available toxicological data that are not accessible in research journal articles or databases, such as PubMed. While ECHA reports and classification and labelling documents were reviewed in an effort to identify as much data as possible, some information in the gray literature may not have been identified. Our search and synthesis of the information in the gray literature relied upon interpretations by authoritative sources (i.e., conclusions available in their reviews and reports).

Third, in reviewing the published literature, formal SRs were not conducted for chemical × health outcome pairings; thus, there may have been some literature that was not identified during our searches. For example, some measures that are common in most animal studies (e.g., brain weight) may not be reported in study titles and abstracts. If relevant endpoints were not discussed in the title and abstract, these studies were not identified in our review process. Additionally, our search for studies examining neurological effects associated with acrolein exposure focused on review articles only. As such, the available primary literature is not summarized in this report but may provide useful information on the effects to the nervous system. Finally, our assessment of the available literature did not include an evaluation of study quality and risk of bias, per SR protocols. While efforts were made to consider the available data in a standardized way, our results should be interpreted with appropriate caution.

Summary

In this scoping review, eight chemicals were considered in high-priority categories (i.e., highest or high) for identification of key health effect data gaps (acrolein, butyl acrylate, 2-butoxyethanol, 2-ethylhexyl acrylate, benzene, hydrogen chloride, phosgene gas, and vinyl chloride) based on available environmental monitoring data, available hazard data, and recency of authoritative reviews. Our review found that irritant was the most established health outcome for the chemicals. Authoritative sources identified all eight chemicals as skin and eye irritants and seven as respiratory irritants. These findings are consistent with symptoms reported by those affected following the train derailment in East Palestine, Ohio.

Most of the chemicals had been evaluated for cancer in experimental animals; however, studies in humans remain a research gap. Five of the eight chemicals were human or animal carcinogens, whereas the remaining three were not classifiable due to inadequate studies, few available studies, or older studies or reviews. Benzene and vinyl chloride are known human carcinogens. Searches and screens conducted to identify human cancer studies in the published literature for acrolein, butyl acrylate, 2-butoxyethanol, and 2-ethylhexyl acrylate did not return any new studies in human populations that would alter cancer conclusions.

Reproductive and developmental outcomes were the most studied noncancer outcomes, and a paucity of conclusions were available from authoritative sources for other noncancer outcomes, including neurological and immunological effects. Two of the eight high-priority chemicals were deemed harmful to reproductive and/or developmental systems, and four were of low or no concern. Two chemicals were associated with both neurological and immunological effects. Suggestive evidence was available for two chemicals for neurological effects and for three chemicals for immunological effects. Relevant data from subsequent searches for neurological and immunological studies in the published literature did not alter these findings.

Results from our review identify and summarize the main health effects data and reveal key health hazard evidence gaps for the chemicals spilled in the East Palestine train derailment. First, additional studies examining neurological effects following exposures to acrolein, butyl acrylate, 2-butoxyethanol, and 2-ethylhexyl acrylate would be useful to better understand potential impacts to the human nervous system following exposure. Our search for studies examining neurological effects associated with acrolein exposure focused on available review articles; thus, primary studies were not reviewed. A systematic review may be warranted to identify and critically assess available primary literature. Next, additional studies of carcinogenic effects in human populations are needed for acrolein and 2-ethylhexyl acrylate based on positive findings in experimental animals. Finally, studies assessing immunotoxicity following 2-butoxyethanol and butyl acrylate exposure should be pursued, as many identified studies reported observational immune findings from studies of general toxicity. Additional research may be needed before pursuit of a systematic review.

This rapid review summarizes the available health hazard data for 20 chemicals released in the East Palestine, Ohio train derailment and subsequent controlled burn. While we aimed to provide information that would be useful context for the health concerns expressed by the affected community and, thus, focused on this specific incident, these chemicals remain in use in a variety of contexts and enter the environment regularly. As such, our evaluation serves to inform the affected individuals and organizations in the East Palestine community, foster further efforts to better characterize health hazards following environmental exposures, and protect the general population from such hazardous health effects in the future.

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Appendix A Phase 2 Supplemental Methods

Table A-1. Population, Exposure, Comparator, and Outcome/Evidence Stream, Exposure, Comparator, and Outcome Statements

Publication Type/Evidence Stream	Population or Evidence Type (Primary Studies)	Exposure[a]	Comparison Group[b]	Outcome[c]
Human epidemiological reviews[d] Post recent IARC publication (2021) Primary epidemiological studies: Post recent IARC publication (2021); not restricted to design • Studies reporting risk estimate or correlation (ecological studies) • Case reports, case series	Humans: Workers, community, not restricted	Acrolein	Low or no exposure to acrolein	Cancer
Human epidemiological, animal, mechanistic reviews	NA	Acrolein	Low or no exposure to acrolein	Neurotoxicity
Human epidemiological reviews[d] Primary epidemiological studies • Studies reporting risk estimate or correlation (ecological studies) • Case reports, case series	Humans: Workers, community, not restricted	2-Butoxyethanol	Low or no exposure to 2-butoxyethanol	Cancer
Human epidemiological, animal, mechanistic reviews Primary epidemiological and toxicology studies • Studies reporting risk estimate or correlation (ecological studies) • Case reports, case series	Humans: Workers, community, not restricted Animals: Nonhuman mammalian	2-Butoxyethanol	Low or no exposure to 2-butoxyethanol	Immunotoxicity
Human epidemiological, animal, mechanistic reviews Primary epidemiological and toxicology studies • Studies reporting risk estimate or correlation (ecological studies) • Case reports, case series	Humans: Workers, community, not restricted Animals: Nonhuman mammalian	2-Butoxyethanol	Low or no exposure to 2-butoxyethanol	Neurotoxicity
Human epidemiological, animal, mechanistic reviews Primary epidemiological and toxicology studies • Studies reporting risk estimate or correlation (ecological studies) • Case reports, case series	Humans: Workers, community, not restricted Animals: Nonhuman mammalian	Butyl acrylate	Low or no exposure to butyl acrylate	Cancer
Human epidemiological, animal, mechanistic reviews Primary epidemiological and toxicology studies • Studies reporting risk estimate or correlation (ecological studies)	Humans: Workers, community, not restricted Animals: Nonhuman mammalian	Butyl acrylate	Low or no exposure to butyl acrylate	Hepatotoxicity

Publication Type/Evidence Stream	Population or Evidence Type (Primary Studies)	Exposure[a]	Comparison Group[b]	Outcome[c]
• Case reports, case series				
Human epidemiological, animal, mechanistic reviews Primary epidemiological and toxicology studies • Studies reporting risk estimate or correlation (ecological studies) • Case reports, case series	Humans: Workers, community, not restricted Animals: Nonhuman mammalian	Butyl acrylate	Low or no exposure to butyl acrylate	Immunotoxicity
Human epidemiological, animal, mechanistic reviews Primary epidemiological and toxicology studies • Studies reporting risk estimate or correlation (ecological studies) • Case reports, case series	Humans: Workers, community, not restricted Animals: Nonhuman mammalian	Butyl acrylate	Low or no exposure to butyl acrylate	Neurotoxicity
Human epidemiological reviews:[d] Post recent IARC publication (2019) Primary epidemiological studies: Post recent IARC publication (2019); not restricted to design • Studies reporting risk estimate or correlation (ecological studies) • Case reports, case series	Humans: Workers, community, not restricted	2-Ethylhexyl acrylate	Low or no exposure to 2-ethylhexyl acrylate	Cancer
Human epidemiological, animal, mechanistic reviews Primary epidemiological and toxicology studies • Studies reporting risk estimate or correlation (ecological studies) • Case reports, case series	Humans: Workers, community, not restricted Animals: Nonhuman mammalian	2-Ethylhexyl acrylate	Low or no exposure to 2-ethylhexyl acrylate	Neurotoxicity

IARC = International Agency for Research on Cancer; NA = not applicable.
[a]Includes all routes, all life stages, and exposure proxies (e.g., biomarkers); does not include endogenous formation.
[b]Case reports/case series do not include a nonexposed control group but are considered supplemental.
[c]Outcomes are defined in Table A-2.
[d]Reviews reporting on individual epidemiological studies.

Table A-2. Health Outcome Concepts

Outcomes	Example Concepts
Cancer	Cancers of any type in the following systems: • Digestive/gastrointestinal • Endocrine • Female reproductive • Head and neck • Hematologic/lymphatic/immune • Hepatic • Male reproductive • Musculoskeletal • Nervous • Respiratory • Skin • Special senses • Systemic • Urinary • Other
Neurotoxicity	Effects to the nervous system in any of the following categories: • Human effect categories o Academic achievement o Attention o Autonomic function o Clinical conditions (e.g., depression, Alzheimer's disease, Parkinson's disease, autism, intellectual disabilities) o Executive function o General intelligence (i.e., IQ) o Hearing impairment o Learning and memory o Motor function o Neurodevelopment o Peripheral nervous system o Social-emotional behavioral regulation o Verbal-language o Visuospatial function o Other • Animal effect categories o Structural (e.g., organ weights; nerve tissue effects; lesions to nerves; impacts to neurons, axons, terminals) o Neurophysiological (e.g., seizures; impacts to electrical activity, including never conduction and action or evoked potentials; tests of electrical activity) o Neurochemical (e.g., impacts to sodium or calcium levels/transmission, impacts to neurotransmitters and receptors, impacts to transport of important neurochemicals) o Behavioral (e.g., sensory, motor, or learning and memory changes; may be measured by functional observation batteries)
Immunotoxicity	• Allergy • Autoimmune diseases (e.g., multiple sclerosis, lupus, rheumatoid arthritis) • General immune assays (e.g., white blood cell counts) • Hypersensitivity • Immunoglobulins (e.g., IgE, IgG, IgM)

Outcomes	Example Concepts
	• Infectious diseases • Serum globulin levels • Vaccine response • White blood cell activity assays • Other
Hepatotoxicity	• Albumin • Albumin/globulin ratio • Bile acids/salts • Bilirubin • Hepatic steatosis/fatty liver • Liver disease • Liver enzymes (e.g., alanine transaminase, aspartate transferase, alkaline phosphatase) • Liver-specific serum biochemistry markers (e.g., gamma-glutamyl transferase, sorbitol dehydrogenase) • Other

Search Strings

Chemical Strings

Acrolein

("107-02-8"[rn] OR "2-Propenal"[tiab] OR "Acrolein"[tiab] OR "Prop-2-enal"[tiab] OR "2-Propen-1-al"[tiab] OR "2-Propen-1-one"[tiab] OR "Acroleina"[tiab] OR "Acrylaldehyd"[tiab] OR "Acrylaldehyde"[tiab] OR "Acrylic aldehyde"[tiab] OR "Allyl aldehyde"[tiab] OR "Aqualin"[tiab] OR "Magnacide B"[tiab] OR "Magnacide H"[tiab] OR "NSC 8819"[tiab] OR "Prop-2-en-1-al"[tiab] OR "Propenal"[tiab] OR "UN 1092"[tiab] OR "DTXSID5020023"[tiab] OR "Acrolein"[mh])

2-Ethylhexyl Acrylate

("103-11-7"[rn] OR "2-Ethylhexyl acrylate"[tiab] OR "2-Ethylhexyl prop-2-enoate"[tiab] OR "2-Propenoic acid, 2-ethylhexyl ester"[tiab] OR "EC No.: 203-080-7"[tiab] OR "2-Ethylhexyl 2-propenoate"[tiab] OR "2-Ethylhexylacrylat"[tiab] OR "2-Propenoic acid 2-ethylhexyl ester"[tiab] OR "2-Propenoic acid, 2-ethylhexyl ester"[tiab] OR "acrilato de 2-etilhexilo"[tiab] OR "ACRYLATE, 2-ETHYLHEXYL"[tiab] OR "Acrylic acid, 2-ethylhexyl ester"[tiab] OR "ACRYLSAEURE-(2-AETHYLHEXYL)-ESTER"[tiab] OR "NSC 4803"[tiab] OR "Octyl acrylate"[tiab] OR "PROP-2-ENOATE, 2-ETHYLHEXYL"[tiab] OR "DTXSID9025297"[tiab])

Butyl Acrylate

("Butyl acrylate"[tiab] OR "141-32-2"[rn] OR "DTXSID6024676"[tiab] OR "141-32-2"[tiab] OR "2-Propenoic acid, butyl ester"[tiab] OR "ACRYLATE, BUTYL"[tiab] OR "ACRYLIC ACID, BUTYL ESTER"[tiab] OR "Butan-1-yl acrylate"[tiab] OR "Butyl acrylate"[tiab] OR "Butyl prop-2-enoate"[tiab] OR "Butyl propenoate"[tiab] OR "n-Butyl acrylate"[tiab] OR "PROP-2-ENOATE, BUTYL"[tiab] OR "UN 2348 (DOT)"[tiab] OR "2-Propenoic acid butyl ester"[tiab] OR "2-Propenoic acid, n-butyl ester"[tiab] OR "ACRYLATE, BUTYL"[tiab] OR "Acrylic acid butyl ester"[tiab] OR "ACRYLIC ACID, BUTYL ESTER"[tiab] OR "Acrylic acid n-butyl ester"[tiab] OR "ACRYLSAEURE-BUTYLESTER"[tiab] OR "Butyl 2-propenoate"[tiab] OR "Butylacrylat"[tiab] OR "NSC 5163"[tiab] OR "PROP-2-ENOATE, BUTYL"[tiab] OR "UN 2348"[tiab] OR "n-butyl acrylate"[Supplementary Concept])

2-Butoxyethanol

("111-76-2"[rn] OR "2-butoxietanol"[tiab] OR "2-Butoxyethan-1-ol"[tiab] OR "2-Butoxyethanol"[tiab] OR "EGBE"[tiab] OR "Ethanol, 2-butoxy-"[tiab] OR "Ethylene glycol monobutyl ether"[tiab] OR "2-butoxietanol"[tiab] OR "2-Butoxy-1-ethanol"[tiab] OR "2-BUTOXY ETHANOL"[tiab] OR "2-butoxyethanol m"[tiab] OR "2-n-Butoxyethanol"[tiab] OR "3-Oxa-1-heptanol"[tiab] OR "AETHYLENGLYKOL-MONOBUTYLAETHER"[tiab] OR "Bikanol B 1"[tiab] OR "Buchiseru"[tiab] OR "Butoxyethanol"[tiab] OR "Butyl Cellosolve"[tiab] OR "Butyl Cellu-Sol"[tiab] OR "BUTYL GLYCOL"[tiab] OR "Butyl Glysolv"[tiab] OR "Butyl icinol"[tiab] OR "Butyl monoether glycol"[tiab] OR "Butyl Oxitol"[tiab] OR "Chimec NR"[tiab] OR "DB solvent"[tiab] OR "Dowanol EB"[tiab] OR "Eastman EB"[tiab] OR "Ektasolve EB"[tiab] OR "Ethanol, 2-butoxy-"[tiab] OR "ETHYLENE GLYCOL BUTYL ETHER"[tiab] OR "Ethylene glycol mono-n-butyl ether"[tiab] OR "Ethylene glycol n-butyl ether"[tiab] OR "Gafcol EB"[tiab] OR "Glycol butyl ether"[tiab] OR "Glycol EB"[tiab] OR "Glycol monobutyl ether"[tiab] OR "Hydroxyethyl butyl ether"[tiab] OR "K Foam Lo"[tiab] OR "Mearcell 3532"[tiab] OR "Minex BDH"[tiab] OR "Monobutyl glycol ether"[tiab] OR "n-Butoxyethanol"[tiab] OR "n-Butyl cellosolve"[tiab] OR "NSC 60759"[tiab] OR "O-Butyl ethylene glycol"[tiab] OR "Poly-Solv EB"[tiab] OR "UN 2369"[tiab] OR "β-Butoxyethanol"[tiab])

6:2 FTNO

("1-Octanesulfonamide, N-[3-(dimethylamino)propyl]-3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluoro-, N-oxide"[tiab] OR "1-Octanesulfonamide, N-[3-(dimethylnitroryl)propyl]-3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluoro-"[tiab] OR "1-Octanesulfonamide, N-[3-(dimethyloxidoamino)propyl]-3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluoro-"[tiab] OR "80475-32-7"[rn] OR "N-[3-(dimethylamino)propyl]-3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctanesulphonamide N-oxide"[tiab] OR "N-[3-(Dimethyloxidoamino)propyl]-

3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluoro-1-octanesulfonamide"[tiab] OR "N,N-Dimethyl-3-[(3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctane-1-sulfonyl)amino]propan-1-amine N-oxide"[tiab] OR "N,N-Dimethyl-3-{[(3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl)sulfonyl]amino}-1-propanamine N-oxide"[tiab] OR "N,N-Dimethyl-3-((perfluorohexyl)ethylsulfonyl)aminopropanamine N-oxide"[tiab] OR "6:2 FTNO"[tiab] OR "6:2 fluorotelomer sulfonamide amine oxide"[tiab])

6:2 FTSA

("1H,1H,2H,2H-perfluorooctanesulfonic acid"[tiab] OR "1H,1H,2H,2H-Perfluorooctanesulfonic acid"[tiab] OR "1-Octanesulfonic acid, 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluoro-"[tiab] OR "27619-97-2"[rn] OR "2-(Perfluorohexyl)ethane-1-sulfonic acid"[tiab] OR "2-(Perfluorohexyl)ethanesulfonic acid"[tiab] OR "3,3,4,4,5,5,6,6,7,7,8,8,8-Tridecafluoro-1-octanesulfonic acid"[tiab] OR "3,3,4,4,5,5,6,6,7,7,8,8,8-Tridecafluoroctansulfonsaure"[tiab] OR "3,3,4,4,5,5,6,6,7,7,8,8,8-Tridecafluorooctane-1-sulfonic acid"[tiab] OR "3,3,4,4,5,5,6,6,7,7,8,8,8-Tridecafluorooctanesulfonic acid"[tiab] OR "3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctanesulphonic acid"[tiab] OR "6:2 Fluorotelomer sulfonic acid"[tiab] OR "Acide 3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctanesulfonique"[tiab] OR "Fluorotelomer sulfonic acid 6:2"[tiab] OR "6:2 FtS"[tiab] OR "6:2 FTS"[tiab] OR "6:2 FTSA"[tiab] OR ("fluorotelomer sulfonic acids" [Supplementary Concept] AND 6:2[tiab]))

Health Outcome Strings

Note that health outcome strings are based on SWIFT-Review search filters (Sciome 2023).

Cancer

(acanthoma*[tiab] OR acrochord*[tiab] OR acrospiroma*[tiab] OR adamantinoma*[tiab] OR adenoacanthoma*[tiab] OR adenoameloblast*[tiab] OR adenocarcin*[tiab] OR adenofibrom*[tiab] OR adenol*[tiab] OR adenom*[tiab] OR "adenosquamous"[tiab] OR ameloblast*[tiab] OR androblast*[tiab] OR angiofib*[tiab] OR angiog*[tiab] OR angiok*[tiab] OR angiol*[tiab] OR angiom*[tiab] OR "angiomatosis"[tiab] OR "angiomatosis"[mh] OR "angiosarc*"[tiab] OR "antibodies, neoplasm"[tiab] OR "antibodies, neoplasm"[mh] OR "antigens, neoplasm"[tiab] OR "antigens, neoplasm"[mh] OR apudom*[tiab] OR argentaffin*[tiab] OR arrhenoblast*[tiab] OR astroblast*[tiab] OR astrocytom*[tiab] OR astrogliom*[tiab] OR "atypia"[tiab] OR "baltoma"[tiab] OR "barrett esophagus"[tiab] OR "barrett esophagus"[mh] OR blastom*[tiab] OR "cancer"[tiab] OR cancero*[tiab] OR "cancers"[tiab] OR carcinog*[tiab] OR "carcinogenicity tests"[tiab] OR "carcinogenicity tests"[mh] OR "carcinogens"[tiab] OR "carcinogens"[mh] OR carcinoid*[tiab] OR carcinom*[tiab] OR carcinos*[tiab] OR cavernom*[tiab] OR "cell line, tumor"[tiab] OR "cell line, tumor"[mh] OR cementom*[tiab] OR cerumin*[tiab] OR chloroma*[tiab] OR cholangio*[tiab] OR chondrob*[tiab] OR chondrom*[tiab] OR chondros*[tiab] OR chord*[tiab] OR chorioa*[tiab] OR choriocarc*[tiab] OR chorioep*[tiab] OR chorionep*[tiab] OR chromaffinom*[tiab] OR collagenom*[tiab] OR comedocarcinom*[tiab] OR condylom*[tiab] OR "condylomata acuminata"[tiab] OR "condylomata acuminata"[mh] OR corticotrop*[tiab] OR craniopharyng*[tiab] OR cylindrom*[tiab] OR cystadeno*[tiab] OR cystoma*[tiab] OR cystosa*[tiab] OR dentinom*[tiab] OR dermatofibro*[tiab] OR "dermoid"[tiab] OR "desmoid"[tiab] OR desmoplastic*[tiab] OR "dictyota"[tiab] OR dysgerm*[tiab] OR dyskerat*[tiab] OR "dysmyelopoiesis"[tiab] OR dysplas*[tiab] OR ectomesenchym*[tiab] OR elastofibr*[tiab] OR enchondrom*[tiab] OR endotheliom*[tiab] OR ependymo*[tiab] OR epidermoid*[tiab] OR epitheliom*[tiab] OR erythrol*[tiab] OR erythropl*[tiab] OR esthesioneuro*[tiab] OR etiolog*[tiab] OR fibroaden*[tiab] OR fibrochond*[tiab] OR fibroe*[tiab] OR fibrofol*[tiab] OR fibroid*[tiab] OR fibrolip*[tiab] OR fibrom*[tiab] OR fibroodontom*[tiab] OR fibrosarcom*[tiab] OR fibrothecom*[tiab] OR fibroxantho*[tiab] OR ganglioblast*[tiab] OR gangliocytom*[tiab] OR ganglioglom*[tiab] OR ganglioneuro*[tiab] OR gastrinom*[tiab] OR "genes, neoplasm"[tiab] OR "genes, neoplasm"[mh] OR germinom*[tiab] OR glioblast*[tiab] OR gliom*[tiab] OR glomangio*[tiab] OR glucagonom*[tiab] OR gonadoblastom*[tiab] OR gonocytom*[tiab] OR gynandroblastom*[tiab] OR haemangio*[tiab] OR hamartom*[tiab] OR hemangio*[tiab] OR hepatoblastom*[tiab] OR hepatom*[tiab] OR hibernom*[tiab] OR hidradenom*[tiab] OR hidrocy*[tiab] OR hodgkin*[tiab] OR hydatidiform*[tiab] OR hydradenom*[tiab] OR hypernephrom*[tiab] OR "IARC"[tiab] OR immunocytom*[tiab] OR insulinom*[tiab] OR leiomyo*[tiab] OR lesion*[tiab] OR leukaemia*[tiab] OR leukemia*[tiab] OR leukoplak*[tiab] OR leukostas*[tiab] OR

"leukostasis"[tiab] OR "leukostasis"[mh] OR lipoadenom*[tiab] OR lipoblastom*[tiab] OR lipom*[tiab] OR liposarcom*[tiab] OR luteinom*[tiab] OR luteom*[tiab] OR lymphangio*[tiab] OR lymphoepitheliom*[tiab] OR lymphom*[tiab] OR lymphoscintigraph*[tiab] OR macroglobulinem*[tiab] OR macroprolactinom*[tiab] OR malignan*[tiab] OR maltom*[tiab] OR masculinovoblastom*[tiab] OR mastocyto*[tiab] OR "mcf-7"[tiab] OR "medullo*"[tiab] OR "meigs syndrome"[tiab] OR melanoa*[tiab] OR melanocytom*[tiab] OR melanom*[tiab] OR meningio*[tiab] OR mesenchymom*[tiab] OR mesonephrom*[tiab] OR mesotheliom*[tiab] OR metaplas*[tiab] OR "metaplasia"[tiab] OR "metaplasia"[mh] OR metasta*[tiab] OR microgliom*[tiab] OR micrometastas*[tiab] OR "mucositis"[tiab] OR "mucositis"[mh] OR mycosis fungoides*[tiab] OR myelodysplas*[tiab] OR "myelodysplastic syndromes"[tiab] OR "myelodysplastic syndromes"[mh] OR "myelodysplastic-myeloproliferative diseases"[tiab] OR "myelodysplastic-myeloproliferative diseases"[mh] OR "myelofibrosis"[tiab] OR myelol*[tiab] OR myeloma*[tiab] OR myeloproliferat*[tiab] OR "myeloproliferative disorders"[tiab] OR "myeloproliferative disorders"[mh] OR myelosuppression*[tiab] OR myoblastom*[tiab] OR myoepitheliom*[tiab] OR myofibro*[tiab] OR myolipom*[tiab] OR myoma*[tiab] OR myosarcom*[tiab] OR myxof*[tiab] OR myxom*[tiab] OR "naevus"[tiab] OR neoplas*[tiab] OR "neoplasm proteins"[tiab] OR "neoplasm proteins"[mh] OR "neoplasms"[tiab] OR "neoplasms"[mh] OR "neoplastic stem cells"[tiab] OR "neoplastic stem cells"[mh] OR nephroblastom*[tiab] OR neurilem*[tiab] OR neurinom*[tiab] OR neuroblastom*[tiab] OR neurocytom*[tiab] OR neuroepitheliom*[tiab] OR neurofibro*[tiab] OR neurolipocytom*[tiab] OR neuroma*[tiab] OR neuronevus[tiab] OR neurothekeom*[tiab] OR "nevus"[tiab] OR "non coding RNA"[tiab] OR nonseminom*[tiab] OR odontoam*[tiab] OR odontom*[tiab] OR oligoastrocytom*[tiab] OR oligodendrogliom*[tiab] OR oncocytom*[tiab] OR "oncogen*"[tiab] OR "oncogene fusion"[tiab] OR "oncogene fusion"[mh] OR "oncogene proteins"[tiab] OR "oncogene proteins"[mh] OR "oncogenic viruses"[tiab] OR "oncogenic viruses"[mh] OR oncolog*[tiab] OR "oncolytic viruses"[tiab] OR "oncolytic viruses"[mh] OR oncoprotein*[tiab] OR "opsoclonus-myoclonus"[tiab] OR orchioblastom*[tiab] OR osteoblastom*[tiab] OR osteoch*[tiab] OR osteofibrosarcom*[tiab] OR osteom*[tiab] OR osteosarcom*[tiab] OR pancreatoblastom*[tiab] OR papillom*[tiab] OR parachordom*[tiab] OR paragangliom*[tiab] OR paraneoplas*[tiab] OR perineuriom*[tiab] OR phaeochromocytom*[tiab] OR pheochromo*[tiab] OR pilomatri*[tiab] OR plasmacytom*[tiab] OR pneumoblast*[tiab] OR pneumocytom*[tiab] OR polyembryom*[tiab] OR polyhistiom*[tiab] OR polyp*[tiab] OR "polyps"[tiab] OR "polyps"[mh] OR porocarcinom*[tiab] OR porom*[tiab] OR pre-cancer*[tiab] OR precancer*[tiab] OR preleukaem*[tiab] OR preleukem*[tiab] OR prelymphom*[tiab] OR pre-lymphom*[tiab] OR pre-malign*[tiab] OR premalignan*[tiab] OR preneoplas*[tiab] OR pre-neoplas*[tiab] OR prolactinom*[tiab] OR protooncogen*[tiab] OR pseudotum*[tiab] OR reninom*[tiab] OR retinoblastom*[tiab] OR rhabdo*[tiab] OR "RNA, neoplasm"[tiab] OR "RNA, neoplasm"[mh] OR sarcoma*[tiab] OR schwannom*[tiab] OR "SEER program"[tiab] OR "SEER program"[mh] OR seminom*[tiab] OR "sentinel lymph node"[tiab] OR "sentinel lymph node biopsy"[tiab] OR "sentinel lymph node biopsy"[mh] OR "sertoli-leydig cell tumor"[tiab] OR "sezary syndrome"[tiab] OR somatostatinom*[tiab] OR somatotropinom*[tiab] OR spermatocytom*[tiab] OR spiradenom*[tiab] OR spongioblastom*[tiab] OR subependymom*[tiab] OR thecom*[tiab] OR thymom*[tiab] OR trichilemmom*[tiab] OR trichoadenom*[tiab] OR trichoblastom*[tiab] OR trichodiscom*[tiab] OR trichoepitheliom*[tiab] OR trichofolliculom*[tiab] OR tricholemm*[tiab] OR "tumor"[tiab] OR "tumor markers, biological"[tiab] OR "tumor markers, biological"[mh] OR tumorgen*[tiab] OR tumorig*[tiab] OR tumor-inhibit*[tiab] OR tumorog*[tiab] OR "tumors"[tiab] OR "tumors"[tiab] OR "tumour"[tiab] OR up-regulat*[tiab] OR vipom*[tiab] OR waldenstrom*[tiab] OR xantho*[tiab])

Neurological

(acetylcholine*[tiab] OR "ADHD"[tiab] OR adrenergic*[tiab] OR "adrenoleukodystrophy"[tiab] OR afferent*[tiab] OR "agoraphobia"[tiab] OR alzheimer*[tiab] OR amacrine*[tiab] OR "amnesia"[tiab] OR "amygdala"[tiab] OR "angelman-syndrome"[tiab] OR "anorexia"[tiab] OR antisocial*[tiab] OR anxiet*[tiab] OR anxious*[tiab] OR aphasi*[tiab] OR "aphonia"[tiab] OR apraxia*[tiab] OR "arachnoid"[tiab] OR "arousal"[tiab] OR astrocyte*[tiab] OR ataxia*[tiab] OR attention-deficit*[tiab] OR autis*[tiab] OR autonomic*[tiab] OR axon*[tiab] OR "baroreflex"[tiab] OR binge-eat*[tiab] OR "bipolar"[tiab] OR bovine-spongiform*[tiab] OR "brain"[tiab] OR "bulimia"[tiab] OR canavan*[tiab] OR cannabinoid*[tiab] OR "capgras"[tiab] OR cerebellar*[tiab] OR cerebral*[tiab] OR cerebro*[tiab] OR "cervical-cord"[tiab] OR charcot-marie-tooth*[tiab] OR "child behavior"[tiab] OR chronic-fatigue*[tiab] OR "circumventricular"[tiab]

OR "cockayne-syndrome"[tiab] OR "cognition"[tiab] OR "cognitiv*"[tiab] OR "corpus callosum"[tiab] OR "cortical"[tiab] OR cranial*[tiab] OR "craniocerebral"[tiab] OR creutzfeldt-jakob*[tiab] OR "cyclothymi*"[tiab] OR "delirium"[tiab] OR "dementia"[tiab] OR demyelinat*[tiab] OR dendrit*[tiab] OR "dentate-gyrus"[tiab] OR "depressed"[tiab] OR "depression"[tiab] OR developmental-disabilit*[tiab] OR "dissociative"[tiab] OR dopamine*[tiab] OR "down-syndrome"[tiab] OR "drug-abuse"[tiab] OR "dura-matter"[tiab] OR dysautonomia*[tiab] OR dyscalcul*[tiab] OR dyskines*[tiab] OR dyslexi*[tiab] OR "dysphonia"[tiab] OR dyssomnia*[tiab] OR dyston*[tiab] OR eating-disorder*[tiab] OR efferent*[tiab] OR "encephalitis"[tiab] OR encephalo*[tiab] OR "entorhinal cortex"[tiab] OR ependy*[tiab] OR "epilep*"[tiab] OR "epithalamus"[tiab] OR "essential-tremor"[tiab] OR excitatory amino acid*[tiab] OR "extra-pyramidal"[tiab] OR extrapyramidal*[tiab] OR "fibromyalgia"[tiab] OR "friedreich ataxia"[tiab] OR "fronto-temporal"[tiab] OR frontotemporal*[tiab] OR ganglia*[tiab] OR ganglion*[tiab] OR "glia"[tiab] OR "glial"[tiab] OR "gliogenesis"[tiab] OR glossopharyngeal*[tiab] OR "gray-matter"[tiab] OR guillain-barre*[tiab] OR "hemiplegia"[tiab] OR hippocamp*[tiab] OR huntington*[tiab] OR "hydranencephaly"[tiab] OR hydrocephal*[tiab] OR "hyperkinesis"[tiab] OR hypochondr*[tiab] OR "hypokinesia"[tiab] OR hypomani*[tiab] OR "hypotha*"[tiab] OR insomnia*[tiab] OR "intell*"[tiab] OR "interneuron"[tiab] OR "inter-neuron"[tiab] OR intracranial*[tiab] OR "IQ"[tiab] OR "ischemi*"[tiab] OR "learning"[tiab] OR leukodystrophy*[tiab] OR leukoencephal*[tiab] OR lewy-bod*[tiab] OR limbic*[tiab] OR "memory"[tiab] OR meningeal*[tiab] OR "meninges"[tiab] OR meningitis*[tiab] OR "meningoencephalitis"[tiab] OR "mesencephalon"[tiab] OR microglia*[tiab] OR mononeuropath*[tiab] OR "mood"[tiab] OR motor-skill*[tiab] OR movement-disorder*[tiab] OR multiple-personalit*[tiab] OR "Munchausen"[tiab] OR muscarinic*[tiab] OR muscular-dystroph*[tiab] OR "myalgia*"[tiab] OR myasthen*[tiab] OR "myeli*"[tiab] OR "myoclonus"[tiab] OR "myokymia"[tiab] OR myopath*[tiab] OR "myositis"[tiab] OR myotoni*[tiab] OR nerve*[tiab] OR "nervous system"[tiab] OR "nervous system"[mh] OR "nervous system diseases"[tiab] OR "nervous system diseases"[mh] OR "nervous system physiological phenomema"[tiab] OR "nervous system physiological phenomema"[mh] OR nervous*[tiab] OR neural*[tiab] OR "neurit*"[tiab] OR "neuroaspergillosis"[tiab] OR neuroaxon*[tiab] OR neuro-axon*[tiab] OR neurobehav*[tiab] OR neurodegenerat*[tiab] OR "neuroeffector"[tiab] OR neuroendocrine*[tiab] OR neurofib*[tiab] OR neurofun*[tiab] OR neurogen*[tiab] OR "neuroglia*"[tiab] OR "neuroim*"[tiab] OR neurokinin*[tiab] OR neurologic*[tiab] OR neuromuscular*[tiab] OR neuromyelitis*[tiab] OR neuron*[tiab] OR neuropath*[tiab] OR "neuropil"[tiab] OR neurosecret*[tiab] OR neurotox*[tiab] OR neurotrans*[tiab] OR "neurotransmitter agents"[tiab] OR "neurotransmitter agents"[mh] OR nicotinic*[tiab] OR nissl-bod*[tiab] OR obsessive-compulsive*[tiab] OR "OCD"[tiab] OR oculomotor*[tiab] OR "olfact*"[tiab] OR "oligodendroglia"[tiab] OR ophthalmoplegia*[tiab] OR palsy*[tiab] OR "panic"[tiab] OR parahippocamp*[tiab] OR "paraly*"[tiab] OR parano*[tiab] OR "paraparesis"[tiab] OR "paraplegia"[tiab] OR parasomnia*[tiab] OR "paresis"[tiab] OR parkinson*[tiab] OR perforant*[tiab] OR perimeningeal*[tiab] OR "personality"[tiab] OR phob*[tiab] OR "pica"[tiab] OR piloerect*[tiab] OR pineal*[tiab] OR pituitary*[tiab] OR plasticity*[tiab] OR "poliomyelitis"[tiab] OR polyneuropath*[tiab] OR polyradicul*[tiab] OR "potentia*"[tiab] OR prader-willi*[tiab] OR "premenstrual dysphoric disorder"[tiab] OR presynap*[tiab] OR "primary dysautonomias"[tiab] OR prion*[tiab] OR propriocept*[tiab] OR "prosencephalon"[tiab] OR "psychiatry and psychology category"[tiab] OR "psychiatry and psychology category"[mh] OR psychomotor*[tiab] OR purinergic*[tiab] OR "radicul*"[tiab] OR receptor*[tiab] OR "receptors, cell surface"[tiab] OR "receptors, cell surface"[mh] OR reflex*[tiab] OR "rett-syndrome"[tiab] OR "rhabdomyolysis"[tiab] OR "rhombencephalon"[tiab] OR rhythm*[tiab] OR schizophreni*[tiab] OR schwann-cell*[tiab] OR sclerosis*[tiab] OR scrapi*[tiab] OR "season* affective disorder"[tiab] OR seizure*[tiab] OR senil*[tiab] OR sensation*[tiab] OR "sensory gating"[tiab] OR seroton*[tiab] OR sleep*[tiab] OR somatosensory*[tiab] OR speech*[tiab] OR spinal-cord*[tiab] OR spinocerebellar*[tiab] OR "stress"[tiab] OR "stroke"[tiab] OR subarachnoid*[tiab] OR subdural*[tiab] OR "substance abuse"[tiab] OR "substantia-nigra"[tiab] OR synap*[tiab] OR "syncope"[tiab] OR tauopath*[tiab] OR "thalamic"[tiab] OR tic-disorder*[tiab] OR tourette*[tiab] OR "vagal"[tiab] OR vagus*[tiab] OR "vertigo"[tiab] OR "voice disorders"[tiab] OR "white-matter"[tiab] OR "williams-syndrome"[tiab] OR "wolfram-syndrome"[tiab])

Liver/Hepatic

((portal[tiab] AND hypertension[tiab]) OR ("alanine aminotransferase"[tiab] OR "alanine aminotransferase"[mh] OR "alkaline phosphatase"[tiab] OR "alkaline phosphatase"[mh] OR aspartate

aminotransferase*[tiab] OR "aspartate aminotransferases"[tiab] OR "aspartate aminotransferases"[mh] OR bilirubin*[tiab] OR bilirubin*[mh] OR cholestasis*[tiab] OR cirrhosis*[tiab] OR "erythropoietic protoporphyria"[tiab] OR "extrahepatic"[tiab] OR "fascioliasis"[tiab] OR "focal nodular hyperplasia"[tiab] OR hepatic*[tiab] OR hepatitis*[tiab] OR "hepato"[tiab] OR hepatobil*[tiab] OR "hepatoc*"[tiab] OR "hepatocytes"[tiab] OR "hepatocytes"[mh] OR hepatolent*[tiab] OR hepatomeg*[tiab] OR hepatopulm*[tiab] OR hepato-pulm*[tiab] OR hepatorenal*[tiab] OR hepato-renal*[tiab] OR hepatotox*[tiab] OR hepato-tox*[tiab] OR hyperbilirubin*[tiab] OR "hyperbilirubinemia"[tiab] OR "hyperbilirubinemia"[mh] OR intrahepatic*[tiab] OR intra-hepatic*[tiab] OR jaundice*[tiab] OR "liver"[tiab] OR "liver"[mh] OR "liver diseases"[tiab] OR "liver diseases"[mh] OR "liver function tests"[tiab] OR "liver function tests"[mh] OR liver*[tiab] OR porphyria*[tiab] OR "Reye syndrome"[tiab] OR "Reye syndrome"[mh]))

Immunological

(diabetes[tiab] AND type 1[tiab]) OR (hepatitis[tiab] AND autoimmune[tiab]) OR (addison*[tiab] OR adhesin*[tiab] OR agglutinat*[tiab] OR allergen*[tiab] OR allergi*[tiab] OR alpha-fetoprotein*[tiab] OR anaphylatoxin*[tiab] OR anemi*[tiab] OR angiotensin*[tiab] OR antibod*[tiab] OR anticoagulan*[tiab] OR "antifibrinolytic agents"[tiab] OR antigen*[tiab] OR "antigens"[tiab] OR "antigens"[mh] OR antisickling agent*[tiab] OR antithrombin*[tiab] OR "arrestin"[tiab] OR arthritis*[tiab] OR autoantigen*[tiab] OR autocoid*[tiab] OR autoimmun*[tiab] OR basophil*[tiab] OR b-cell*[tiab] OR bleed*[tiab] OR "blood physiological phenomena"[tiab] OR "blood physiological phenomena"[mh] OR "blood proteins"[tiab] OR "blood proteins"[mh] OR blood*[tiab] OR b-lymphocyt*[tiab] OR "bone-marrow"[tiab] OR "cd25"[tiab] OR "cd27"[tiab] OR "cd28"[tiab] OR "cd29"[tiab] OR "cd3"[tiab] OR "cd4"[tiab] OR "cd45"[tiab] OR "cd8"[tiab] OR chemokine*[tiab] OR "churg-strauss syndrome"[tiab] OR coagulat*[tiab] OR "coccidioidin"[tiab] OR "crp"[tiab] OR cytokine*[tiab] OR cytophagocytos*[tiab] OR dendrit*[tiab] OR dermatitis*[tiab] OR eicosanoid*[tiab] OR enterochromaffin*[tiab] OR eosinophil*[tiab] OR epitheloid-cell*[tiab] OR "epitope mapping"[tiab] OR erythrocyte*[tiab] OR fibrin-clot*[tiab] OR fibrinoly*[tiab] OR fluoroimmunoas*[tiab] OR foam-cell*[tiab] OR gamma-globulin*[tiab] OR giant cell*[tiab] OR glomerulonephritis*[tiab] OR granulocyte*[tiab] OR "graves disease"[tiab] OR guillain-barre*[tiab] OR "haematopoietic"[tiab] OR "haemic"[tiab] OR hemangioma*[tiab] OR hematinic*[tiab] OR hematocrit*[tiab] OR "hematologic agents"[tiab] OR "hematologic agents"[mh] OR "hematologic diseases"[tiab] OR "hematologic diseases"[mh] OR "hematologic tests"[tiab] OR "hematologic tests"[mh] OR hematologic*[tiab] OR hematop*[tiab] OR "hemic and immune systems"[tiab] OR "hemic and immune systems"[mh] OR hemocyte*[tiab] OR hemoglo*[tiab] OR "hemolytic"[tiab] OR hemophil*[tiab] OR hemorheolog*[tiab] OR hemorrhag*[tiab] OR hemostas*[tiab] OR hemostatic*[tiab] OR histamine*[tiab] OR histocompatib*[tiab] OR "histoplasmin"[tiab] OR "host-resistance"[tiab] OR hyperresponsiv*[tiab] OR hypersensitiv*[tiab] OR "il-6"[tiab] OR "il-8"[tiab] OR "immune system diseases"[tiab] OR "immune system diseases"[mh] OR "immune system phenomena"[tiab] OR "immune system phenomena"[mh] OR immune*[tiab] OR immunit*[tiab] OR immunoassay*[tiab] OR immunobl*[tiab] OR immunochroma*[tiab] OR immunoco*[tiab] OR immunog*[tiab] OR immunolog*[tiab] OR "immunologic techniques"[tiab] OR "immunologic techniques"[mh] OR "immunologic tests"[tiab] OR "immunologic tests"[mh] OR immunom*[tiab] OR immunophenotyp*[tiab] OR immunopr*[tiab] OR immunosuppress*[tiab] OR immunotherap*[tiab] OR immunotox*[tiab] OR inflamm*[tiab] OR "inflammation"[tiab] OR "inflammation"[mh] OR "inflammation mediators"[tiab] OR "inflammation mediators"[mh] OR "insulin-dependent"[tiab] OR interferon*[tiab] OR interleukin*[tiab] OR isoimmunizat*[tiab] OR killer cell*[tiab] OR kinin*[tiab] OR kupffer-cell*[tiab] OR langerhans*[tiab] OR "lepromin"[tiab] OR leukocyte*[tiab] OR leukopoies*[tiab] OR lupus*[tiab] OR lymphoc*[tiab] OR lymphokine*[tiab] OR lymphom*[tiab] OR lymphop*[tiab] OR macrophage*[tiab] OR mast-cell*[tiab] OR monocyte*[tiab] OR monokine*[tiab] OR "multiple sclerosis"[tiab] OR "myasthenia gravis"[tiab] OR myelop*[tiab] OR "neprilysin"[tiab] OR neutrophil*[tiab] OR nk-cell*[tiab] OR "osmotic fragility"[tiab] OR phagocyt*[tiab] OR "plasma"[tiab] OR platelet*[tiab] OR polyradiculoneuropath*[tiab] OR prostaglandin*[tiab] OR protein-c-deficienc*[tiab] OR prothrombin*[tiab] OR purpura*[tiab] OR radioim*[tiab] OR reticulocyt*[tiab] OR rheumatoid*[tiab] OR sensitiz*[tiab] OR serodiagnosis*[tiab] OR serotyp*[tiab] OR sperm agglutinat*[tiab] OR "spleen"[tiab] OR "splenic"[tiab] OR splenocyte*[tiab] OR staphylococc*[tiab] OR t-cell*[tiab] OR "t-helper"[tiab] OR thrombin*[tiab] OR thromboc*[tiab] OR thrombop*[tiab] OR "thymic"[tiab] OR thymocyte*[tiab] OR thymus*[tiab] OR t-lympho*[tiab] OR "tnf

alpha"[tiab] OR "transverse myelitis"[tiab] OR "trichophytin"[tiab] OR vaccinat*[tiab] OR vaccine*[tiab] OR von-willebrand*[tiab])

Population Strings

Note that population strings are based on SWIFT-Review search filters (Sciome 2023).

Human

(humans[mh] OR "human development"[mh]) OR (human[tiab] OR Humans[tiab] OR person[tiab] OR people[tiab]) OR ((“age groups”[mh]) OR (pediatric[tiab] OR pediatrician[tiab] OR paediatric[tiab] OR paediatrician[tiab] OR baby [tiab]OR babies[tiab] OR toddler[tiab] OR toddlers[tiab] OR child[tiab] OR children[tiab] OR youth[tiab] OR youngster[tiab] OR tween[tiab] OR tweens[tiab] OR teen[tiab] OR teens[tiab] OR teenager[tiab] OR teenagers[tiab] OR teenaged[tiab]) OR (("in utero"[tiab] OR prenatal[tiab] OR perinatal[tiab] OR neonatal[tiab] OR postnatal[tiab]) NOT (mice[tiab] OR mouse[tiab] OR rat[tiab] OR rats[tiab]))) OR (preschool[tiab] OR preschooler[tiab] OR pre-school[tiab] OR kindergarten[tiab] OR kindergartener[tiab] OR schoolchild[tiab] OR schoolchildren[tiab] OR student[tiab] OR students[tiab]) OR ("middle age"[tiab] OR “middle-aged”[tiab] OR aged[tiab] OR elder[tiab] OR elderly[tiab] OR "senior citizen"[tiab] OR seniors[tiab] OR retiree[tiab] OR septuagenarian[tiab] OR octagenarian[tiab] OR sexagenarian[tiab] OR nonagenarian[tiab] OR centenarian[tiab]) OR ("nuclear family"[mh]) OR (family[tiab] OR families[tiab] OR parent[tiab] OR parents[tiab] OR father[tiab] OR fathers[tiab] OR mother[tiab] OR mothers[tiab] OR sibling[tiab] OR siblings[tiab] OR brother[tiab] OR brothers[tiab] OR sister[tiab] OR sisters[tiab] OR twin[tiab] OR twins[tiab] OR "stepfather"[tiab] OR "step father"[tiab] OR "stepmother"[tiab] OR "step mother"[tiab] OR "stepdaughter"[tiab] OR "step daughter"[tiab] OR "stepson"[tiab] OR "step son"[tiab] OR aunt[tiab] OR aunts[tiab] OR uncle[tiab] OR uncles[tiab] OR niece[tiab] OR nieces[tiab] OR nephew[tiab] OR nephews[tiab] OR grandparent[tiab] OR grandparents[tiab] OR grandfather[tiab] OR "grand father"[tiab] OR grandmother[tiab] OR "grand mother"[tiab] OR grandchild[tiab] OR granddaughter[tiab] OR grandson[tiab] OR spouse[tiab] OR spouses[tiab] OR spousal[tiab] OR partner[tiab] OR partners[tiab] OR husband[tiab] OR husbands[tiab] OR wife[tiab] OR wives[tiab] OR guardian[tiab] OR caregiver[tiab] OR caregivers[tiab] OR "care giver"[tiab]) OR (men[mh] OR women[mh]) OR (men[tiab] OR man[tiab] OR boy[tiab] OR boys[tiab] OR boyhood[tiab] OR women[tiab] OR woman[tiab] OR girl[tiab] OR girls[tiab] OR girlhood[tiab]) OR ("population groups"[mh] OR "vulnerable populations"[mh]) OR ("african american"[tiab] OR "asian american"[tiab] OR hispanic[tiab] OR latina[tiab] OR latino[tiab] OR "mexican american"[tiab] OR underserved[tiab] OR disadvantaged[tiab]) OR ("epidemiologic studies"[mh] OR "double-blind method"[mh] OR "single-blind method"[mh]) OR (epidemiology[mh]) OR ("case control"[tiab] OR cohort[tiab] OR "cross sectional"[tiab] OR "follow-up study"[tiab] OR longitudinal[tiab] OR prospective[tiab] OR retrospective[tiab]) OR ("case reports"[mh] OR "clinical trial"[mh] OR "observational study"[mh] OR "randomized control trial"[mh] OR "twin study"[mh]) OR ("clinical trial"[tiab] OR observational[tiab] OR "randomized control trial"[tiab]) OR ("research subjects"[mh] OR "human experimentation"[mh] OR patients[mh] OR "Patient Participation"[mh]) OR ("human subjects"[tiab] OR "research subjects"[tiab] OR clients[tiab] OR patient[tiab] OR inpatient[tiab] OR outpatient[tiab] OR participants[tiab] OR volunteers[tiab]) OR ("occupational groups"[mh] OR "occupational exposure"[mh]) OR (occupation[tiab] OR occupational[tiab] OR workplace[tiab] OR "work place"[tiab] OR "work-related"[tiab] OR administrators[tiab] OR aides[tiab] OR assistants[tiab] OR crew[tiab] OR crews[tiab] OR employees[tiab] OR personnel[tiab] OR professional[tiab] OR staff[tiab] OR technicians[tiab] OR workers[tiab] OR educators[tiab] OR instructors[tiab] OR teachers[tiab] OR clinicians[tiab] OR doctors[tiab] OR physicians[tiab] OR pharmacists[tiab] OR nurses[tiab] OR residents[tiab] OR veterinarians[tiab]) OR (epidemiologic[tiab])

Animal

"animal experimentation”[mh] OR "models, animal”[mh] OR "behavior, animal”[mh] OR "animal population groups”[mh] OR "invertebrates”[mh] OR "chordata, nonvertebrate”[mh] OR "amphibians”[mh] OR "birds”[mh] OR "fishes”[mh] OR "reptiles”[mh] OR "carnivora”[mh] OR "insectivora”[mh] OR "lagomorpha”[mh] OR "rodentia”[mh] OR "strepsirhini”[mh] OR "platyrrhini”[mh] OR "tarsii”[mh] OR

"cercopithecidae"[mh] OR "hylobatidae"[mh] OR "gorilla gorilla"[mh] OR "pan paniscus"[mh] OR "pan troglodytes"[mh] OR "pongo pygmaeus"[mh] OR "Animals"[mh] OR "chordata"[mh] OR "vertebrates"[mh] OR "mammals"[mh] OR "primates"[mh] OR "haplorhini"[mh] OR "catarrhini"[mh] OR "hominidae"[mh] OR animal[tiab] OR animals[tiab] OR mice[tiab] OR mus[tiab] OR mouse[tiab] OR murine[tiab] OR rats[tiab] OR rat[tiab] OR murinae[tiab] OR muridae[tiab] OR "cotton rat"[tiab] OR "cotton rats"[tiab] OR hamster[tiab] OR hamsters[tiab] OR rodent[tiab] OR rodents[tiab] OR pigs[tiab] OR pig[tiab] OR swine[tiab] OR piglet[tiab] OR piglets[tiab] OR "guinea pigs"[tiab] OR "guinea pig"[tiab] OR cavia[tiab] OR callithrix[tiab] OR marmoset[tiab] OR marmosets[tiab] OR cebuella[tiab] OR hapale[tiab] OR octodon[tiab] OR chinchilla[tiab] OR chincillas[tiab] OR gerbillinae[tiab] OR gerbil[tiab] OR gerbils[tiab] OR rabbit[tiab] OR rabbits[tiab] OR hares[tiab] OR hare[tiab] OR cats[tiab] OR cat[tiab] OR carus[tiab] OR felis[tiab] OR dogs[tiab] OR dog[tiab] OR canine[tiab] OR canines[tiab] OR canis[tiab] OR haplorhini[tiab] OR monkey[tiab] OR monkeys[tiab] OR anthropoid[tiab] OR saguinus[tiab] OR tamarin[tiab] OR leontopithecus[tiab] OR hominidae[tiab] OR ape[tiab] OR apes[tiab] OR "pan paniscus"[tiab] OR bonobo[tiab] OR "pan troglodytes"[tiab] OR gibbon[tiab] OR gibbons[tiab] OR nomascus[tiab] OR symphalangus[tiab] OR chimpanzee[tiab] OR chimpanzees[tiab] OR chimp[tiab] OR chimps[tiab] OR prosimian[tiab] OR pongidae[tiab] OR gorilla[tiab] OR gorillas[tiab] OR "pongo pygmaeus"[tiab] OR orangutan[tiab] OR orangutans[tiab] OR lemur[tiab] OR lemurs[tiab] OR lemuridae[tiab] OR chicken[tiab] OR chickens[tiab] OR gallus[tiab] OR quail[tiab] OR quails[tiab] OR bird[tiab] OR birds[tiab] OR poultry[tiab] OR fowl[tiab] OR fowls[tiab] OR reptile[tiab] OR reptiles[tiab] OR turtle[tiab] OR turtles[tiab] OR amphibian[tiab] OR frog[tiab] OR frogs[tiab] OR xenopus[tiab] OR bombina[tiab] OR salientia[tiab] OR toad[tiab] OR toads[tiab] OR "epidalea calamita"[tiab] OR salamander[tiab] OR fish[tiab] OR fishes[tiab] OR pisces[tiab] OR catfish[tiab] OR perch[tiab] OR percidae[tiab] OR perca[tiab] OR trout[tiab] OR char[tiab] OR salmon[tiab] OR salvelinus[tiab] OR minnow[tiab] OR cyprinidae[tiab] OR carp[tiab] OR zebrafish[tiab] OR "zebra fish"[tiab] OR nematode[tiab] OR elegans[tiab] OR diptera[tiab] OR flies[tiab] OR dipteral[tiab] OR drosophila[tiab]

Study Type

Reviews

("Meta-Analysis"[pt] OR "Review"[pt] OR "Systematic Review" [pt] OR review[ti] OR metaanalysis[tiab] OR case-report[tiab] OR metaanalyses[tiab] OR meta-analysis[tiab] OR meta-analyses[tiab])

Appendix B Supplementary Results for Phases 1 and 2

Detailed extractions of authoritative source reports and resources are available in the Excel file "East Palestine_Rapid Scoping_Phase 1 Extractions." The file is available as a separate document.

Table B-1. Detailed Findings from Phase 1 Authoritative Source Reviews for 15 East Palestine Chemicals of Interest

Chemicals (CASRN)	Cancer	Nervous	Immune	Developmental	Reproductive	Other Organs	Skin Sensitiza-tion	Skin Irritation	Eye Irritation	Respiratory Irritation
Highest-priority Chemicals										
Acrolein (107-02-8)	IARC Group 2A (Probably) Gap: Human	Gap: Suggestive, no conclusion	Gap: Suggestive, no conclusion	No risk or concern: Guideline study	Low risk or concern: Guideline study	*Cardio and metabolic*: Suggestive *GI*: Stomach irritant in animals; RA [animals]	Suggestive, no conclusion	Irritant: Category 1B	Irritant: Category 1; RA [humans]	Irritant: RA [humans]
Butyl Acrylate (141-32-2)	IARC Group 3: Inadequate evidence from animal studies (negative) (1999)	Gap: No or few studies	Gap: No or few studies	No risk or concern: Guideline study	No risk or concern: Guideline study	*Hepatic*: Suggestive, no conclusion	Sensitizing: Category 1	Irritant: Category 2	Irritant: Category 2	Irritant: RA [animals]
Ethylene Glycol Monobutyl Ether (EGBE or 2-Butoxyethanol) (111-76-2)	IARC Group 3: Hemangiosarcoma and forestomach in animals (2006) Gap: Human	Gap: Suggestive, no conclusion	Gap: Suggestive, no conclusion	Low risk or concern: Positive effects at doses causing maternal toxicity in animal studies	Low risk or concern: Positive effects at high doses	*Hemo*: Causes hematotoxicity; RA [humans] *Hepatic*: Causes liver toxicity; RA [animals]	No or low concern	Irritant: Category 2	Irritant: Category 2; RA [humans]	Irritant: RA [humans]
2-Ethylhexyl Acrylate (103-11-7)	IARC Group 2B (Possibly) Skin, animal studies (2019) Gap: Human	Gap: No or few studies	Gap: No or few studies	No or low concern	No or low concern	Gap: No or few studies	Sensitizing: Category 1	Irritant: Category 2	Irritant: Category 2	Irritant: RA [animals]
High-priority Chemicals										
Benzene (71-43-2)	IARC Group 1 (Known) for humans RA [humans]	Evidence indicates neurotoxicity from high exposure (e.g., workplace) in humans	Adverse effects in humans RA [humans]	Causes developmental effects [hematotoxicity] in animals; RA [animals] Gap: Human	May harm the reproductive system (limited evidence)	*Hemo*: Bone marrow depression; RA [humans] *GI*: Suggestive	No or low concern	Irritant: Category 2	Irritant: Category 2	Gap: Suggestive, no conclusion
Hydrogen Chloride (7647-01-0)	IARC Group 3: Inadequately designed animal studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	*Renal*: Suggestive, no conclusion	No or low concern	Irritant: Category 1	Irritant: Category 1 RA [humans]	Irritant: RA [humans]

Chemicals (CASRN)	Cancer	Nervous	Immune	Developmental	Reproductive	Other Organs	Skin Sensitization	Skin Irritation	Eye Irritation	Respiratory Irritation
Phosgene Gas (75-44-5)	Gap: No or few studies	Gap: No or few studies	Immune in lung Gap: Suggestive, no conclusion	Gap: No or few studies	Gap: No or few studies	*Respiratory (other than irritation)*: RA [humans]	Gap: No or few studies	Irritant: Category 1	Irritant: Category 1	Irritant: RA [humans]
Vinyl Chloride (75-01-4)	IARC Group 1 (Known) for humans RA [humans]	Presumed for humans	Suspected for humans	Suspected for humans	Gap: No or few studies	*Hepatic*: Presumed liver effects for humans RA [animals]	Sensitizing: Category 1	Irritant: Category 2	RA [humans]	Irritant: RA [humans]
Moderate-priority Chemicals										
Diethylene Glycol (111-46-6)	No carcinogenic potential	Gap: Suggestive, no conclusion	Gap: No or few studies	No or low concern	No or low concern	*Renal*: Suggestive, no conclusion	No or low concern	No or low concern	Negative studies	Gap: Suggestive, no conclusion
Dipropylene Glycol (25265-71-8)	No carcinogenic potential	Gap: No or few studies	Gap: No or few studies	No or low concern	No or low concern	Gap: No or few studies	No or low concern	Irritant: Category 3	Irritant: Category 2A	Gap: No or few studies
Polypropylene Glycol (25322-69-4)	Gap: No or few studies	Gap: Suggestive	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	*Cardiovascular*: Suggestive, no conclusion	No or low concern	Suggestive, no conclusion	Irritant: Category 2A	No or low concern
1,2 Propylene Glycol (57-55-6)	Not likely carcinogenic	Gap: No or few studies	Gap: No or few studies	No or low concern	No or low concern	*Hemo:* Effects (not severe) and hyperglycemia in animals RA [animals]	No or low concern	Suggestive, no conclusion	No or low concern	Suggestive: RA [animals] but overall evidence incon-clusive
Low-priority Chemicals										
Petroleum Lube Oil (64742-58-1)	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No conclusions	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Irritant: Category 2	Irritant: Category 2	Gap: No or few studies
Polyethylene (9002-88-4)	IARC Group 3: Inadequately designed animal studies (1979)	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies
Polyvinyl Alcohol (9002-89-5)	IARC Group 3: Conflicting animal evidence (1979)	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies

CASRN = Chemical Abstracts Service Registry Number; IARC = International Agency for Research on Cancer; GI = gastrointestinal; RA = Risk Estimate Available.

Table B-2. Detailed Findings from Phase 1 Authoritative Source Reviews for Five PFAS Chemicals

Chemical (CASRN)	Cancer	Nervous	Immune	Developmental	Reproductive	Other Organs	Skin Sensitization	Skin Irritation	Eye Irritation	Respiratory Irritation
6:2 FTSHA (88992-45-4)	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Presumed (Category 1B) in guideline animal study	Presumed (Category 1B) in guideline animal study	Gap: No or few studies	Not sensitizing (in vitro); sensitizing in guideline animal study	No or low concern	Irritant: Category 1	Gap: No or few studies
6:2 FTSAS (88992-47-6)	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies
6:2 FTSA (27619-97-2)	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	No or low concern	No or low concern	Gap: No or few studies	No or low concern	Irritant: Category 1B	Irritant: Category 1	Gap: No or few studies
6:2 FTSA-PrB (34455-29-3)	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	Gap: No or few studies	No or low concern	No or low concern	Suggestive: Some irritation in guideline study (reversed in 24 hours)	Gap: No or few studies
6:2 FTNO (80475-32-7)	Gap: No or few studies	No or low concern	Gap: No or few studies	No or low concern	No or low concern	*Cardiovascular*: Suggestive, some decreased serum lipids in guideline studies *Hemo:* No or low concern	No or low concern	No or low concern	No or low concern	Gap: No or few studies

PFAS = per- and polyfluoroalkyl substances; CASRN = Chemical Abstracts Service Registry Number.

Table B-3. Acrolein-Nervous Phase 2 Search Results and Studies from Phase 1 Reviews

Study Citation	Evidence Type	Reference Source[a]				
		Phase 2 Search	ATSDR (2007a)	ECHA[b] (2001)	EPA IRIS (2003b)	OEHHA (2014)
Alarie (1973)	Review, animal only	X	X			
Arlt et al. (2002)	Review, human, animal, mechanistic	X				
Chang et al. (2022)	Review, human and animal	X				
Dorman et al. (2008)	Primary animal					X
Feron et al. (1978)	Primary animal		X			
Igarashi et al. (2018)	Review, human, animal, mechanistic	X				
Igarashi et al. (2020)	Review, human and animal	X				
Iqubal et al. (2020)	Review, human, animal, mechanistic	X				
Kutzman et al. (1984)	Primary animal		X			
Kutzman et al. (1985)	Primary animal		X			
LoPachin et al. (2008)	Review, human, animal, mechanistic	X				
Lovell et al. (2001)	Primary human					X
Lyon et al. (1970)	Primary animal		X	X		X
Moghe et al. (2015)	Review, animal only (no human studies found)	X				
Morris et al. (1999)	Primary animal		X			
Morris et al. (2003)	Primary animal					X
Muguruma et al. (2020)	Review, human only	X				
Parent et al. (1991)	Primary animal		X			
Parent et al. (1992b)	Primary animal		X			
Parent et al. (1992a)	Primary animal		X			
Park and Igarashi (2013)	Review, human, animal, mechanistic	X				
Schroeter et al. (2008)	Primary animal					X

Study Citation	Evidence Type	Reference Source[a]				
		Phase 2 Search	ATSDR (2007a)	ECHA[b] (2001)	EPA IRIS (2003b)	OEHHA (2014)
Singh et al. (2010)	Review, human, animal, mechanistic	X				
Sprince et al. (1979)	Primary animal		X			
Springall et al. (1990)	Primary animal		X		X	

[a]Studies are identified for authoritative reviews if reports discussed neurological outcomes. Authoritative reviews may have discussed some studies but not reported effects for the health system of interest.
[b]Report published by the European Chemicals Bureau (ECB), a precursor to the European Chemicals Agency (ECHA).

Table B-4. 2-Butoxyethanol-Immune Phase 2 Search Results and Studies from Phase 1 Reviews

Study Citation	Evidence Type	Reference Source[a]			
		Phase 2 Search	ATSDR (1998)	EPA IRIS (2010)	OEHHA (2018)
Song et al. (2017)	Primary human	X			
Carpenter et al. (1956)	Primary animal		X		
Chereshnev et al. (2014)	Primary animal	X			X
CMA (1983)	Primary animal		X		
CMA (1993)	Primary animal		X		
Dodd et al. (1983)	Primary animal	X	X		X
Duprat and Gradiski (1979)	Primary animal		X		
Eastman Kodak (1983)	Primary animal		X		
Exon et al. (1991)	Primary animal	X	X	X	X
Ghanayem et al. (1987a)	Primary animal	X	X	X	
Ghanayem et al. (1987b)	Primary animal		X		
Ghanayem et al. (1992)	Primary animal		X		
Grant et al. (1985)	Primary animal	X	X	X	
Greenspan et al. (1995)	Primary human		X		
Krasavage (1986)	Primary animal	X	X		
Nachreiner (1994)	Primary animal		X		
NTP (1989)	Primary animal		X		
NTP (1993)	Primary animal		X		
Shepard (1994)	Primary animal		X		
Singh et al. (2001)	Primary animal	X		X	X
Smialowicz et al. (1992)	Primary animal	X	X	X	X
Starek et al. (2008)	Primary animal	X			
Tyl et al. (1984)	Primary animal		X		
Union Carbide (1989a)	Primary animal		X		
Union Carbide (1989b)	Primary animal		X		
Werner et al. (1943a)	Primary animal		X		
Werner et al. (1943b)	Primary animal		X		
Zissu (1995)	Primary animal		X		

[a]Studies are identified for authoritative reviews if reports discussed immune outcomes. Authoritative reviews may have discussed some studies but not reported effects for the health system of interest.

Table B-5. 2-Butoxyethanol-Nervous Phase 2 Search Results and Studies from Phase 1 Reviews

Study Citation	Evidence Type	Reference Source[a]			
		Phase 2 Search	ATSDR (1998)	EPA IRIS (2010)	OEHHA (2018)
Bauer et al. (1992)	Case report, human		X	X	X
Burkhart and Donovan (1998)	Case report, human	X		X	
Carpenter et al. (1956)	Primary animal and human		X	X	X
CMA (1983)	Primary animal		X		
Dean and Krenzelok (1992)	Case series, human	X	X	X	X
Dodd et al. (1983)	Primary animal		X		
Dow (1986)	Primary animal		X		
Eastman Kodak (1983)	Primary animal		X		
Gijsenbergh et al. (1989)	Case report, human		X	X	X
Gualtieri et al. (2003)	Case report, human			X	X
Krasavage (1986)	Primary animal		X		
Litovitz et al. (1991)	Case report, human		X		
NTP (1993)	Primary animal		X		
Nyska et al. (1999)	Primary animal	X			
Osterhoudt (2002)	Case report, human	X		X	
Rambourg-Schepens et al. (1988)	Case report, human		X	X	X
Wier et al. (1987)	Primary animal		X		

[a]Studies are identified for authoritative reviews if reports discussed neurological outcomes. Authoritative reviews may have discussed some studies but not reported effects for the health system of interest.

EXHIBIT 20

PEOPLE'S ACTION INSTITUTE
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October 17, 2023

Ms. Jami Wallace
President
Unity Council for the East Palestine Train Derailment
East Palestine, OH

Re: EPA's Dioxin Testing in East Palestine, OH Conducted March – April, 2023

Overview and Key Findings

The dioxin testing conducted by Norfolk Southern in response to the train derailment and subsequent intentional burning of vinyl chlorine and other toxic chemicals in East Palestine, OH fails to address many questions raised by local residents about their potential exposure to dioxins. People continue to ask EPA for more testing which the agency continues to deny. Based on this analysis of the EPA's testing approach and results, additional testing is clearly needed. This additional testing should be designed to address the public health risks posed by the contamination caused by the derailment and subsequent burning of vinyl chloride and other toxic chemicals.

Based on the data provided by EPA and the information provided to support that data and how it was collected, it is not possible to tell 1) where dioxin contamination is or isn't, or 2) what the concentrations of dioxins are at a given location. Furthermore, EPA did not disclose the actual location of any of the samples that were collected. This is an important because it is needed to evaluate and to understand the public health risks posed by the results.

Key Findings

- The initial sampling plan developed by Arcadis for Norfolk Southern and approved by EPA was never intended to identify the public health risks posed by the contamination in the community caused by the derailment and subsequent intentional burning of vinyl chloride and other toxic chemicals.

- The approach for determining where to collect samples used by Arcadis for Norfolk Southern and approved by EPA was highly unusual and very subjective, and did not follow standard procedures for investigating contaminated sites. Norfolk Southern's

sampling plan involved walking the area and "inspecting" the surface soil for evidence of ash or other debris from the derailment and subsequent intentional burn.

- Despite the many limitations in EPA's testing approach, some sample measurements did detect significant levels of dioxins. A significant number of samples that were collected as part of EPA's dioxin sampling effort in East Palestine did exceed EPA and other benchmarks and guidelines for evaluating the public health risks of dioxins and warrant additional action. Yet, EPA has refused to conduct additional testing or take any action to address these findings.

- No information is provided on the actual location of where samples were taken. Subsequently, it's unclear how close collected samples were to the immediate site of the derailment and intentional burn and how many samples were taken from downwind of the immediate site of the derailment and intentional burn. It's also unclear if the samples with significant concentrations of dioxins reflect hot spots or other evidence of contamination from the emissions fallout from the derailment and intentional burn.

- EPA has not shared comprehensive sampling details that would allow the community and its scientific advisors to independently evaluate this sampling effort. The agency has also failed to provide transparency in its sampling and analytical procedures. Once sampling has been conducted, results have not been released in a transparent, accessible, or easy to understand manner. This unconventional approach has made it difficult to independently evaluate and understand the public health risks posed by the dioxin concentrations reported in the results.

- The community has given EPA ample opportunities to build trust, engage with the public, and provide information. EPA has responded with a complicated presentation of its results in which nothing is clear and little makes sense, rather than being forthcoming about its plans, processes and results.

- EPA provided no analysis of their dioxin sampling results.

EPA needs to conduct additional testing in the areas where significant concentrations of dioxins were found in order to evaluate if these areas represent hotspots or whether there are other reasons why the concentrations of dioxins were high in these areas. A scientist appointed by the community needs to be included in this follow-up testing and investigation. It is also evident that EPA needs to take action to communicate to residents living near these sample locations.

Analysis of EPA's Dioxin Testing in East Palestine, OH

On February 3, 2023 a Norfolk Southern Railway Company freight train derailed in East Palestine, Ohio. Twenty of the derailed cars contained hazardous chemicals including vinyl chloride, butyl acrylate, ethylene glycol, monobutyl ether, ethylhexyl acrylate and isobutylene. Some cars released these chemicals into the surrounding air, soil, and water when the train derailed. Then, on February 6, Norfolk Southern made the decision to conduct an intentional burn of five tanker cars containing vinyl chloride, a highly toxic and hazardous substance. This intentional burn resulted in the formation and release of a by-product of burning the vinyl chloride – a group of chemically-related substances, generally described as "dioxins," one of the most toxic chemicals ever created. Nearby residents were evacuated because of the health hazards posed by breathing the fumes and smoke from the derailment and then the intentional burn. In addition to the fumes and smoke, chemicals released into the surrounding environment posed additional public health risks. The Ohio Department of Natural Resources found that over seven miles of streams were affected by the chemical spill and thousands of fish died, raising concerns about dangers to residents in a large radius surrounding the spill.

The U.S. Environmental Protection Agency (EPA) ordered Norfolk Southern to identify and clean up contaminated soil and water. However, secrecy surrounding the scale of the accident and a reluctance to test thoroughly for all chemicals of concern has frustrated residents. Despite initial reluctance to test for dioxins, EPA announced on March 2, 2023 that it would test for dioxins in the areas impacted by the train derailment. The community had been urging the agency to do this testing for weeks. On March 13, 2023, the community along with dozens of national organizations and community-based organizations signed a letter to EPA detailing their concerns about the testing, and seeking transparency and community involvement in the testing design and sampling plan. Recommendations for how this testing could be conducted to address these concerns were included in this letter report. Unfortunately, EPA did not address these concerns and recommendations in the development of the sampling plan which was prepared by Arcadis a contractor for Norfolk Southern.

EPA's testing for dioxins was conducted from March 9th to April 7th. Samples were collected from surface and subsurface soil, and the results were made publicly available on EPA's website on April 21, 2023. This report summarizes these results and provides our analysis of this effort.

Overview of Samples Collected for Dioxins

130 surface soil samples and 133 subsurface soil samples were collected over 23 days for analysis. Surface samples were collected from a depth of 0 to 0.1 feet (zero to just over 1 inch) below the top surface of the soil. Subsurface samples were collected from a depth of 0.1 to 0.5 feet (from just over 1" to 6 ") below the top surface of the soil. Figure 1 shows the number and type of samples collected on each day. During the first 6 days of sampling, ten or more samples were collected each day. On the subsequent 17 days, 1 to 7 samples were collected on each day. EPA did not provide information about how the number of samples collected each day or the sampling locations were determined.

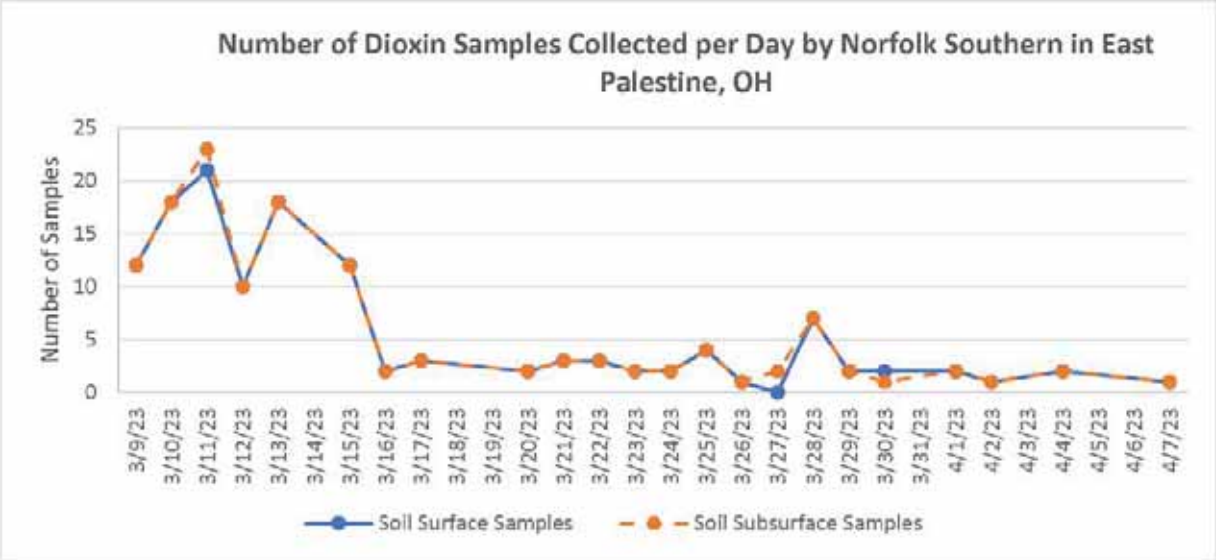


Figure 1 – Number of Dioxin Samples Collected from Surface and Subsurface Soil Each Day by the Norfolk Southern in East Palestine, OH.

The most striking aspect of the dioxin soil sampling effort was the approach used for determining where to collect samples. The sampling plan was developed by Arcadis, a contractor for Norfolk Southern, and approved by EPA. This plan was highly unusual and did not follow standard procedures for investigating contaminated sites or areas. Norfolk Southern's approach involved walking the area and "inspecting" the surface soil for evidence of ash or other debris from the derailment and subsequent intentional burn as the primary way of identifying where samples will be taken (Arcadis Report, p. 1). This approach is unscientific and unprofessional primary because it is highly subjected and subject to bias that can influence the results. This is not what one would expect in a situation like the one in East Palestine. In fact, in fact, in over 40 years of evaluating contaminated sites, I've never seen EPA approve a soil sampling plan that was this vague and subjective.

It is not clear why EPA chose to collect subsurface as well as surface samples. In the March 6, 2023 soil sampling plan prepared by Arcadis, no reason is given for why subsurface samples were included in the sampling plan. It is surprising that they collected samples from subsurface soil as part of the sampling plan. The primary route of exposure of the pollutants resulting from the train derailment and subsequent intentional burn was transport of chemicals through the air as particulates and as volatile and semi-volatile substances. The anticipated impact area would have been primarily surface soil downwind from the site of the rail accident and intentional burn. In addition, dioxins are generally not water soluble, so transport of dioxins through the surface soil to the subsurface soil would not be expected.

Perhaps the reason that subsurface soil samples were collected was to gain general background information on the soil in the area impacted by the derailment and subsequent intentional burn. The contractor for Norfolk Southern described the goal of this sampling effort as follows:

> "The purpose of this Plan is to guide soil inspection and sampling efforts on residential, commercial, and agricultural properties within the area identified for surface soil assessment in the UAO. The inspection and soil sampling described below will be conducted as a preliminary step to evaluate whether shallow soil within that area has been impacted by constituents released during the vent and burn, specifically, by ash transported by aerial deposition and landing on soil" (Arcadis Report, p. 1).

The main concern raised when this plan was released was that the sampling and testing was not intended to identify the public health risks posed by the contamination throughout the community. It is a mystery why this would not have been the purpose of the dioxin sampling effort in East Palestine. This matters because the purpose of the plan determines the sampling that will be done and where the samples will be taken from. A more public health approach would include testing in areas where people live and where people directly experienced the smoke cloud from the derailment and intentional burn. Surprisingly, there is no mention in the sampling plan report about addressing the public health risks posed by the contamination caused by the burning of vinyl chloride and other toxic chemicals.

In this analysis, we did look at the subsurface soil data but decided not to include it in this report as it we did not deem this data to be relevant to the concerns about the presence of dioxins in surface soil in the areas impacted by the train derailment and subsequent intentional burn.

In the March 13, 2023 letter to EPA, the community asked that the agency lead the dioxin sampling "to provide transparency, rebuild public trust and comprehensively address the possible releases of dioxins from the disaster." Included in this letter were requests for the following information:

- Goals and objective of the sampling plan;
- What environmental media – soil, dust, water, sediment, air – will be sampled;
- Sample locations for each medium type. It must include communities that were in the path of the plume;
- The number of samples that will be collected for each medium type;
- Sample collection procedures for each medium type;
- Detection limits for each medium type;
- Analytical procedures for each medium type;
- Which suite of dioxins will be analyzed. Total polychlorinated dioxins and furans should be measured as well as PCBs, especially the dioxin-like PCBs; and
- Details on quality control/quality assurance procedures.

Unfortunately, Norfolk Southern began collecting samples before EPA responded to this letter and most of these requests were ignored. The laboratory that conducted the sample analyses for Norfolk Southern did include the standard analytic test for dioxins which includes 17 different forms (congeners) of dioxin and other dioxin-like substances including dibenzofurans. The data EPA posted on its website did include testing results for these 17 dioxin congeners. However, neither EPA nor Norfolk Southern requested that the analyses include measurements for polychlorinated chlorinated biphenyls (PCBs) which also would have formed as a result of the intentional burning of vinyl chloride. PCBs are considered dioxin-like substances because they behave like dioxins in the body and cause dioxin-like toxicity.

Another limitation in the lab analyses is that the lab did not generate a total dioxin equivalent or TEQ value for the sum of all the dioxins present in a particular sample. Generating a TEQ value for dioxin samples is normally standard operating procedure because it's the gold standard for analyzing the potential health risks posed by dioxin found in soil, air or water. It was up to EPA or Norfolk Southern to request that the lab generate TEQ values for each sample.

Without a TEQ value for each sample, we are left with a complicated set of results that are more difficult to understand and interpret, especially in the context of public health risks. It is not clear whether the directive not to generate a TEQ value came from EPA or Norfolk Southern.

In the absence of a TEQ value for each sample, we decided to focus on the three forms (congeners) of dioxin with the highest toxicity to human health. These are:

- 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)
- 1,2,3,7,8-pentachlorodibenzo-p-dioxin (1,2,3,7,8-PeCDD)
- 2,3,4,7,8-pentachlorodibenzofuran (2,3,4,7,8-PeCDF)

These substances have the highest dioxin toxicity factors, and therefore have the highest concern for public health. In general, these congeners make up a significant portion of the summed TEQ value for a particular sample.

This analysis is significantly further limited because EPA did not disclose the actual location of any of the samples that were collected. This is an important piece of information that is needed to evaluate and to understand the public health risks posed by the results. Without this information, it is not possible to independently evaluate and understand the public health risks posed by dioxin contamination in East Palestine.

Measurement of Dioxin Concentrations in Soil Samples

The concentration of dioxins in the soil samples was reported by EPA in milligrams of a specific form (congener) of dioxin found per kilogram of soil (mg/kg). This concentration is equivalent to 1 part per million (ppm). It's not clear why EPA chose to use this unit of measure since the

concentrations of the dioxins found in the samples were generally at much lower levels. Reporting the results this way makes it harder for people to follow and to understand. To compensate for this added complexity, we have converted the results to parts per trillion (ppt) to make it easier to follow. One mg/kg is equal to 1 x 10^6 parts per trillion (ppt).

Concentration of Dioxins in Surface Soil

The concentration of all three congeners of dioxin for all samples collected from surface soil ranged from 0.22 to 510 parts per trillion (ppt). For 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), the most potent form of dioxin, the concentration in surface soil ranged from 0.22 to 510 parts per trillion (ppt). For 1,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD), an equally potent form of dioxin, the concentration in surface soil ranged from 0.86 to 190 parts per trillion (ppt). For 2,3,4,7,8-pentachlorodibenzofuran (TCDF), the concentration in surface soil ranged from 1.5 to 100 parts per trillion (ppt). These results are summarized in Table 1.

It is clear from these sample results that there are a number of significant concentrations of 2,3,7,8-TCDD and 2,3,4,7,8-PeCDD in these samples. It would be important to identify where these samples were collected from and to evaluate why these samples had such high concentrations. Is it a hot spot of some kind? Was there unique fallout from the smoke cloud that settled there? It is important to conduct additional testing in this area in order to evaluate why these samples reported such high concentrations of dioxins.

We also looked at the average concentration of these same three congeners of dioxin in surface soil. The average concentration of each of the three congeners of dioxin for all samples in surface soil ranged from 5.16 to 6.49 parts per trillion (ppt). For 2,3,7,8-TCDD, the average concentration in surface soil was 6.39 ppt. For 1,2,3,7,8-PeCDD, the average concentration in surface soil was 5.16 ppt and for 2,3,4,7,8-PeCDF, the average concentration in surface soil was 6.49 ppt. These results are summarized in Table 1 below. As stated above, without knowing the actual sample locations, it is difficult to draw conclusions about what this large range of measurements could mean.

Table 1 – Minimum, Average, and Maximum Concentrations of Select Dioxin Congeners in Surface Soil.

Concentration (ppt)	2,3,7,8-TCDD	1,2,3,7,8-PeCDD	2,3,4,7,8-PeCDF
Minimum	0.22	0.86	1.5
Average	6.39	5.16	6.49
Maximum	510	190	100

Average Daily Concentration of Dioxins in Surface Soil

The overall average concentration of each congener is useful, but it is also useful to understand how the concentration of each congener changed over time. To do this, we calculated the average concentration of each dioxin congener on each day. For example, 12 surface soil

samples of each congener were collected on March 9, so we can average together the 12 measured concentrations of 2,3,7,8-TCDD. Doing this for every day samples were collected provides a calculation of the average daily 2,3,7,8-TCDD surface soil concentration. When we did this for TCDD, we found that the average daily surface soil concentration for TCDD ranged from 0.29 ppt to 30 ppt. These results are shown in Figure 2.

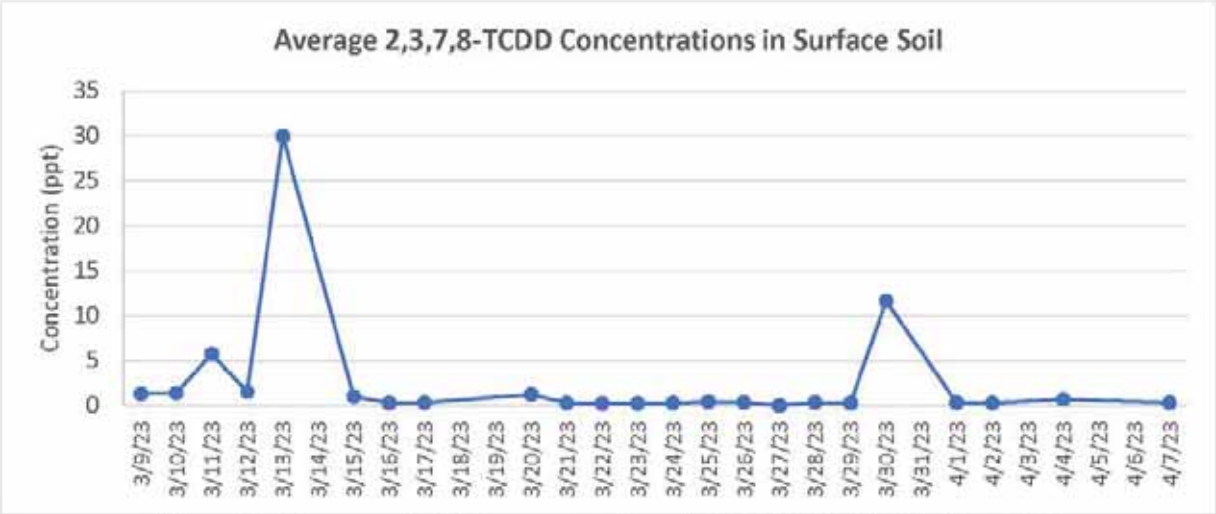


Figure 2 – Average Daily Concentration of 2,3,7,8-TCDD in Surface Soil.

We also did this PeCDD and PeCDF. The average daily surface soil concentration of 1,2,3,7,8-PeCDD ranged from 2.53 ppt to 17 ppt and the average daily surface soil concentration of 2,3,4,7,8-PeCDF ranged from 2.53 ppt to 40 ppt.

What's clear when you do this is that on March 13, 2023 (3/13), the average concentration of all three dioxin congeners in surface soil was an order of magnitude (ten times) higher than the average across all days. Figure 2 shows this for the 2,3,7,8-TCDD results. The highest surface soil concentration measured on 3/13 was 510 ppt. This is a high concentration so it is important to identify the location of this sample and if it is a residential property, to share this result with the people who live there. It's also important to evaluate why this sample had such a high concentration. Is it a hot spot? Was there unique fallout from the smoke cloud that settled there? It is important to conduct additional testing in this area in order to evaluate why this sample reported such a high concentration of dioxins.

EPA did not provide any explanation for the high concentration found on 3/13, especially compared to the results from sampling locations on other days.

Maximum Daily Concentration of Dioxins Found in Surface Soil

With the large range of concentrations measured for each dioxin congener, and the fact that there is potential danger to human health, it is also useful to understand the maximum daily concentration of each dioxin congener. This is particularly important for the two congeners with the highest toxicity, 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD. Maximum surface soil concentrations for each day of sample collection are shown in Figure 3 for 2,3,7,8-TCDD and in Figure 4 for 1,2,3,7,8-PeCDD. In each case, surface soil measurements on 3/13 were two orders of magnitude (one hundred times) higher than on other days.

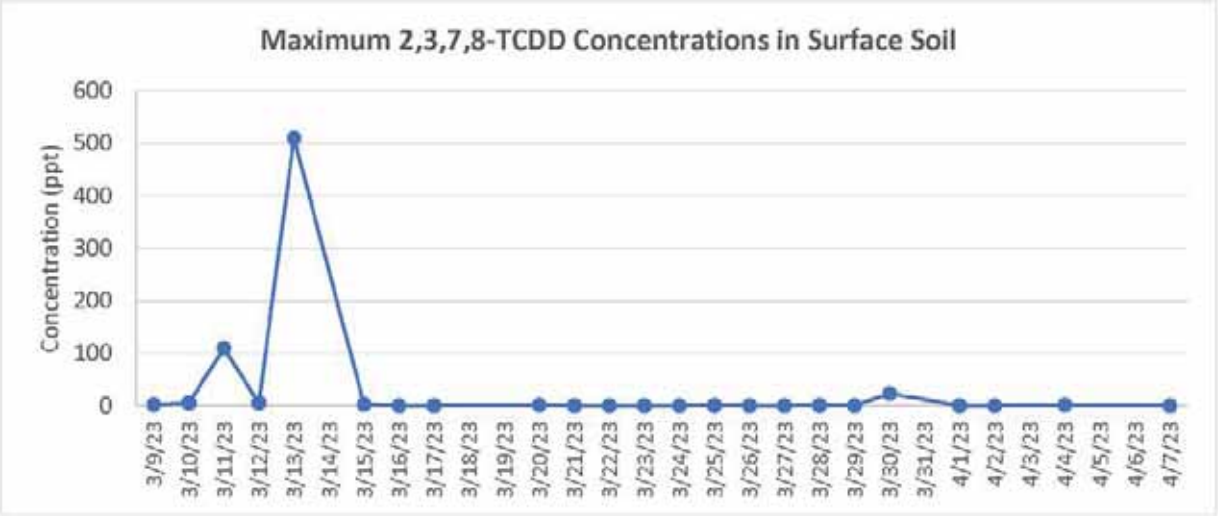


Figure 3 – Maximum Daily Concentration of 2,3,7,8-TCDD in Surface Soil.

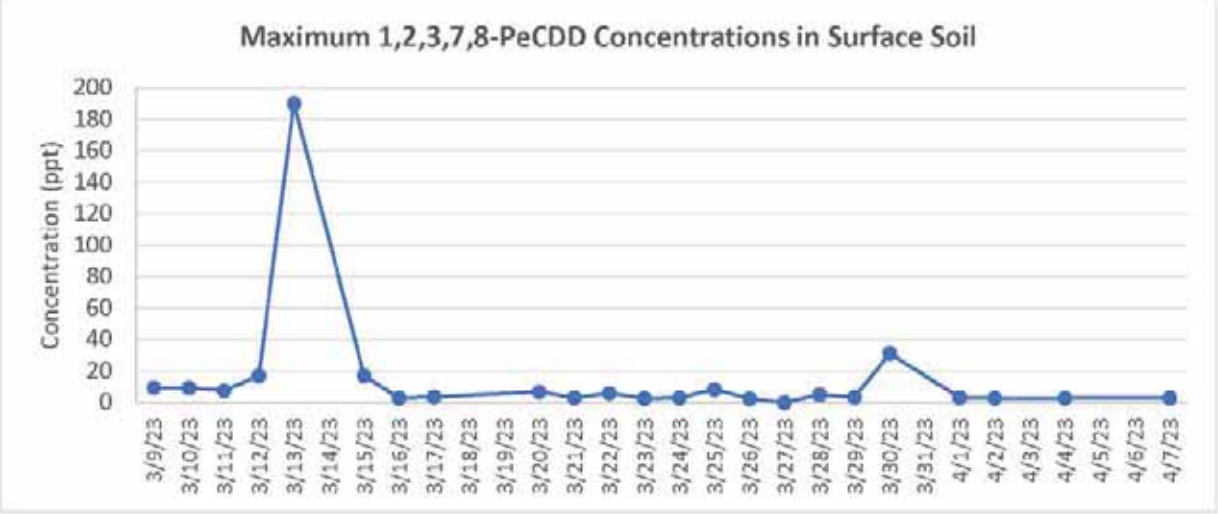


Figure 4 – Maximum Daily Concentration of 1,2,3,7,8-PeCDD in Surface Soil.

Dioxin Concentrations Below the Limit of Detection

In a substantial number of surface samples, the concentration of dioxin was found to be below the limit of detection used by the laboratory. The limit of detection is the lowest concentration of a substance that can be detected in a sample. It is determined by the sensitivity of the procedure used by the laboratory doing the analyses. Because EPA only made a summary of the lab results available to the public, it is not clear what the specific limit of detection was for each congener that was measured. Instead, the EPA summary results indicate a range of values identified as being "below the limit of detection." The results for each dioxin congener are reported this way by EPA without identifying a specific limit of detection.

This unconventional approach makes it difficult to evaluate and to understand the public health risks posed by the results. Without this information, it is not possible to independently evaluate and understand the public health risks posed by the dioxin contamination in East Palestine.

Perhaps not surprisingly given the unusual and unconventional methods and procedures used by Norfolk Southern to collect these samples, a significant number of samples were described by EPA as being below the limit of detection. Of 130 surface soil samples that were collected, more than 69 percent of all samples were reported by EPA to have congener specific dioxin concentrations that were less than the limit of detection. For example, for 2,3,7,8-TCDD 89 of 130 samples (68%) were reported to have concentrations that were less than the limit of detection. For 2,3,4,7,8-PeCDD, 97 of 130 samples (75%) were reported to have concentrations that were less than the limit of detection. And for 2,3,4,7,8-PeCDF, 85 of 130 samples (65%) were reported to have concentrations that were less than the limit of detection. These results are summarized in Figure 5.

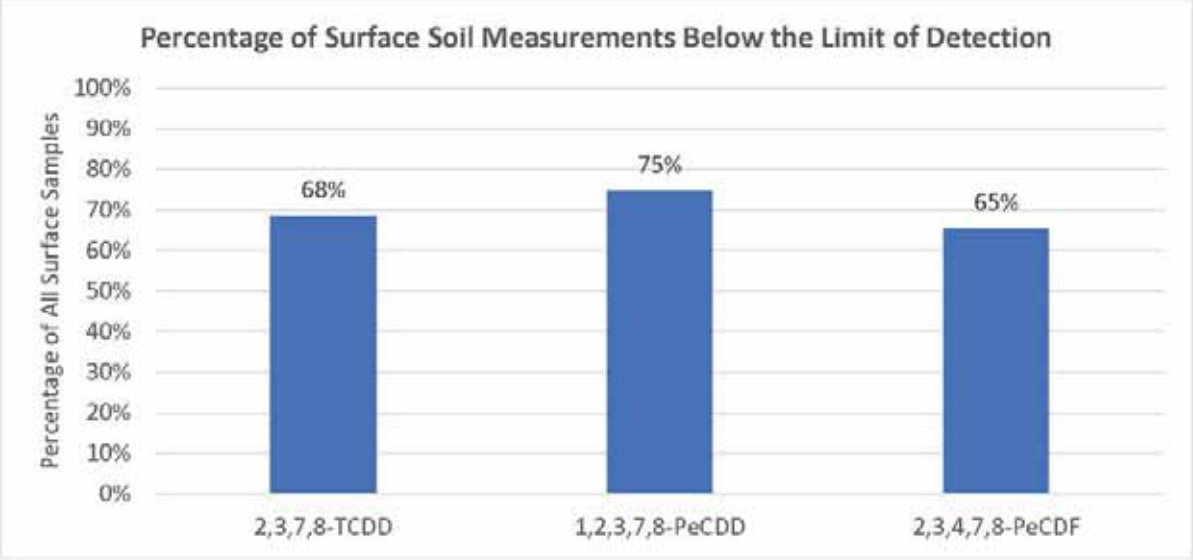


Figure 5 – Percentage of Surface Soil Sample Measurements Below the Limit of Detection for Select Dioxin Congeners.

Considering the many pollutants released into the air as particulates and as volatile and semi-volatile substances from the train derailment and subsequent intentional burn of vinyl chloride and other toxic chemicals, this finding is highly unexpected. The question these results raise is not why so many samples were below the limit of detection, but rather are the results believable at face value? These findings may be a reflection of the unusual and unconventional methods and procedures used by Norfolk Southern to collect these samples, and not a true reflection of the dioxin concentrations in the areas impacted by the train derailment and subsequent intentional burn of vinyl chloride and other toxic chemicals. Additional testing is needed using standard testing procedures to verify these results and provide public confidence that the results accurately reflect the concentration of dioxins in the areas impacted by the derailment and intentional burn.

Dioxin Concentrations Compared to EPA Guidelines

Despite the many limitations and uncertainties in how these samples were collected, one can still consider the results at face value. One way to do this is compare the results to existing guideline or benchmark values. The US EPA has developed Regional Screening Levels (RSLs) to evaluate the potential for adverse effects to human health based on exposure to soil. In this case, we used the EPA's regional screening levels for residential property.

EPA's risk screening level table on their website includes two dioxins: 2,3,7,8-TCDD and a mixture of hexachlorodibenzo-p-dioxins. EPA's risk screening value for 2,3,7,8-TCDD is 4.8 parts per trillion (ppt) for a target cancer risk of one-in-a-million. This is a common health protective acceptable target risk value. The analysis for dioxin in East Palestine did not include a mixture of hexachlorodibenzo-p-dioxin, so that guideline value was put aside.

In addition to the 2,3,7,8-TCDD benchmark value, Arcadis, Norfolk Southern's contractor, proposed risk screening levels (RSLs) for all 17 congener specific dioxins (see page 118 of the Phase 1 Soil Sampling Plan). Table 2 below shows the number of surface soil samples with concentrations that exceeded the EPA's RSL for 2,3,7,8-TCDD as well as Arcadis's proposed RSL values for 1,2,3,7,8-PeCDD and 2,3,4,7,8-PeCDF. In 6 samples (5% of the samples), the concentration of 2,3,7,8-TCDD exceeded the EPA RSL for 2,3,7,8-TCDD. In the case of 1,2,3,7,8-PeCDD, 42 of 130 samples (32%) exceeded the Arcadis proposed RSL for 1,2,3,7,8-PeCDD. None of the samples had concentrations of 2,3,4,7,8-PeCDF that exceeded the Arcadis proposed RSL for 2,3,4,7,8-PeCDF. These results are shown in Table 2.

While this is a minority of samples, it does make clear that there are levels of dioxins in the area worth investigating further. Because EPA has not disclosed the sampling locations, it is unclear how many locations had dioxin concentrations above RSLs. Further still, because it's even unclear if the results occurred at the same location. It's important to identify where these samples were collected from and to evaluate why these samples had such these high concentrations. Is it a hot spot of some kind? Was there unique fallout from the smoke cloud that settled there? It is important to conduct additional testing in the East Palestine area in order to evaluate why these samples reported high concentrations of dioxins.

Table 2 – Number and Percent of Surface Soil Samples of Select Dioxin Congeners Found to be Above EPA's Regional Screening Levels (RSLs).

	2,3,7,8-TCDD	1,2,3,7,8-PeCDD	2,3,4,7,8-PeCDF
EPA's intermediate and chronic Regional Screening Level (RSL) (ppt)	4.8	4.8	16
Number of surface soil samples above RSL	6	42	0
Percent of surface soil samples above RSL	5%	32%	0%

EPA did not provide any analysis of what risks these results may pose to residents, especially if residents live on or near property with high dioxin concentrations. It's not even clear that residents who might live on or near property with high concentrations of dioxins have been informed of these findings.

Another way to assess if concentrations of dioxins are significant and warrant action is to use EPA's guidelines to calculate the total toxic equivalent (TEQ) value for the combination of the dioxins with the highest toxicity, 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD. These calculations can be compared to EPA's proposed (in 2010) Preliminary Remediation Goal (PRG) for dioxin of 3.7 parts per trillion (ppt) TEQ for residential soil. Doing this would provide a conservative estimate of the total TEQ value since only two congeners would be included in the TEQ calculation. This would underestimate the total TEQ value.

EPA itself did not calculate TEQ values for the East Palestine dioxin data, which is concerning because this is the gold standard for analyzing the potential health risks of dioxin concentrations. EPA has done these calculations in other instances of suspected dioxin contamination and provided no explanation for why they were not calculated here. According to EPA, "if an exposure area has an average concentration above the PRG, some level of remediation is needed." The PRG is shown as a black line in Figure 6 below. It's clear from this figure that there are ten days in which the calculated average TEQ value was above EPA's PRG. This suggests that dioxin levels at the locations sampled on these days were significantly high. Because EPA did not provide information about sampling locations, it is unclear how many locations these high TEQs represent or what human activity near those locations may be at risk of exposure. EPA did not did not indicate that remediation efforts would take place in or around these or any sample locations.

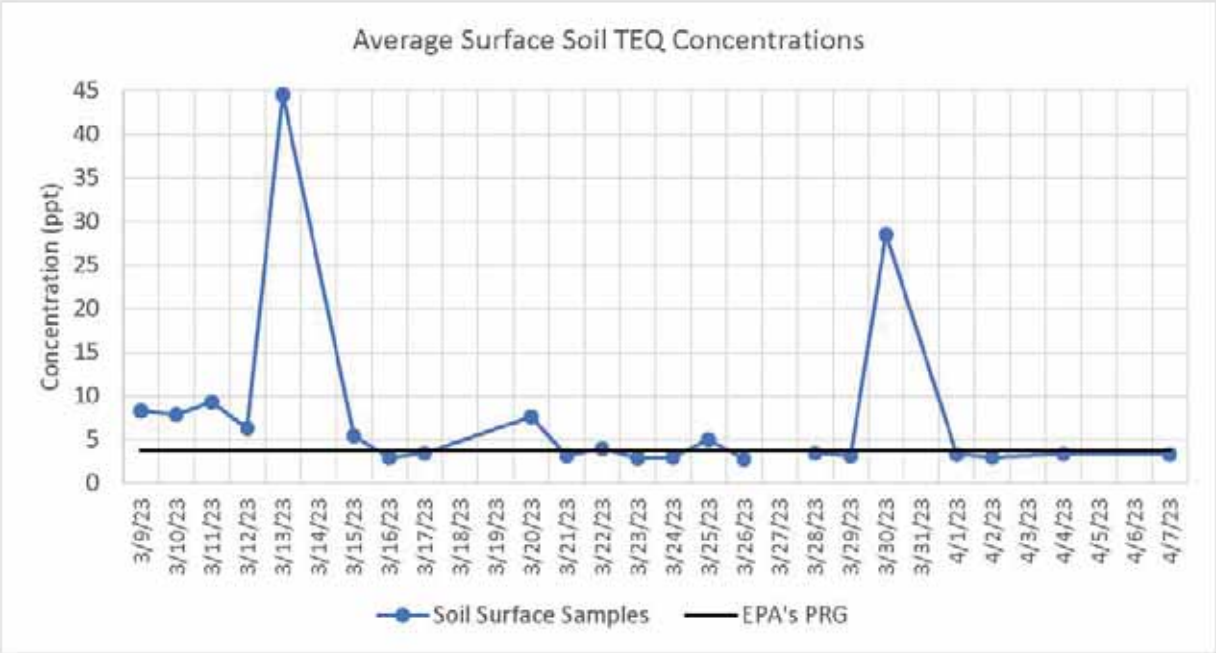


Figure 6 – Average Daily TEQ for the Combination of 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD. The black line reflects the Proposed PRG for Dioxin of 3.7 ppt TEQ for residential soil.

Based on this analysis, it is clear that are a significant number of samples that were collected as part of EPA's dioxin sampling effort in East Palestine exceed EPA and other benchmarks and guidelines for evaluating the public health risks of dioxins and warrant additional action. Specifically, EPA needs to conduct additional testing in the areas where high levels were found in order to evaluate if these areas represent hotspots or whether there are other reasons why the concentration of dioxins were high in these areas. A scientist appointed by the community needs to be included in this follow-up testing and investigation. It is also evident that EPA needs to take action to communicate to residents living near these sample locations if this has not already been done.

Limitations of EPA's Testing and Sampling Plan

There are many limitations in EPA's dioxin testing approach that made the likelihood of finding positive results very small. These limitations include the following:

- The initial sampling plan developed by Arcadis for Norfolk Southern and approved by EPA was never intended to identify the public health risks posed by the contamination in the community caused by the derailment and subsequent intentional burning of vinyl chloride and other toxic chemicals. Arcadis defined the purpose of the proposed sampling plan as "a guide to soil inspection" (Arcadis Report, p. 1). This general description defines what sampling will be done and where the samples will be taken from and is consistent with the vague sampling approach taken by Norfolk Southern.

- The approach for determining where to collect samples developed by Arcadis for Norfolk Southern and approved by EPA was highly unusual and did not follow standard procedures for investigating contaminated sites or areas. Norfolk Southern's "soil inspection" approach involved walking the area and "inspecting" the surface soil for evidence of ash or other debris from the derailment and subsequent intentional burn as the primary way of identifying where samples will be taken (Arcadis Report, p. 1). In over 40 years of evaluating contaminated sites, I've never seen EPA approve a soil sampling plan that was this vague and subjective.

- The samples were collected more than one month after the train derailment, so weather conditions and human activity would likely have interfered with surface soil conditions and influenced the results of the sampling, especially given the "visual" inspection approach used by Norfolk Southern. It's unclear how accurately the surface soil sampling results reflect the emissions fallout from the derailment and intentional burn.

- No information is provided on the actual location of where samples were taken. Subsequently, it's unclear how close collected samples were to the immediate site of the derailment and intentional burn and how many samples were taken from downwind of the immediate site of the derailment and intentional burn. It's also unclear if the samples with significant concentrations of dioxins reflect hot spots or other evidence of contamination from the emissions fallout from the derailment and intentional burn.

- EPA failed to require Norfolk Southern to report its dioxin results in TEQ values. TEQ is the Gold Standard for analyzing and evaluating the potential health risks of dioxin concentrations in soil, air or water. This makes interpreting the results unnecessarily complicated and difficult.

- The EPA and Norfolk Southern failed to request that the lab analyze the soil samples for polychlorinated chlorinated biphenyls (PCBs) which also would have formed as a result of the intentional burning of vinyl chloride. This limits what we know about the public health risks posed by the intentional burning of vinyl chloride and other toxic chemicals by Norfolk Southern.

- No samples collected as part of this effort were taken from the areas directly and immediately impacted by the derailment and subsequent intentional burning of vinyl chloride and other toxic chemicals. As a result, it's unclear what the concentration of dioxins was in the surface soil at the immediate site of the derailment and intentional burn. These areas may have been included as part of other sampling conducted by Norfolk Southern, but if that is the case, those results have not been released to the public and they should be. Without this information, it's not possible to gain a complete and comprehensive understanding of the public health risks posed by the derailment and subsequent intentional burning of vinyl chloride and other toxic chemicals.

Outstanding Questions about EPA's Testing Methodology

Since the initial letter submitted to EPA on March 13, 2023, the community has continued to raise questions about sampling locations, collection, measurement and analysis that have yet to be answered including in the agency's most recent correspondence to Jami Wallace of the Unity Council for East Palestine Train Derailment and Daniel Winston of River Valley Organizing dated September 14, 2023. The following questions remain unanswered or unaddressed by EPA and the residents of East Palestine still want the agency to answer these questions. Full analysis of the data and the potential risks to residents cannot be conducted without this information. Without this information, it's also not possible to determine if the areas impacted by emissions fallout from the derailment and intentional burn have been appropriately and adequately tested for dioxins and other toxic chemicals released during this event.

1. Where are the sampling locations for each measurement?
2. How was the number of samples to be collected on each day chosen?
3. EPA used a nonstandard approach for selecting sample locations that was uncharacteristic, unscientific, and unprofessional. Why was an objective sampling approach (such as a grid plan or concentric circle plan) to get unbiased sampling not used in this situation?
4. Concentrations of congener specific dioxins were significantly high on March 13th and March 30th (and to a lesser extent om March 10th). What were the sample locations on these days and why were the results orders of magnitude higher than most other measurements? If you cannot answer this question, then additional testing needs to be done at these same locations to verify the results and investigate why the concentrations of dioxins were so high at these locations on these days.
5. What were the weather conditions and human activity on each day of sample collection at each sampling location? Weather conditions such as wind or rain and human activity could affect sample collection, measurement, and interpretation.
6. The community's ability to analyze and interpret the data is significantly limited by the fact that the number and locations of samples have not been provided by EPA. How does EPA intend for the community to use this data without that information?
7. Why did EPA not release any data analysis along with its summary measurements of dioxins?
8. In the past EPA has calculated TEQs for dioxins – why was that not done for each measurement here?
9. Can EPA provide the actual laboratory results for all the surface soil sampling results for dioxins?
10. Does EPA intend to investigate the high dioxin concentrations that were found as part of this initial soil sampling effort? If not, why not.

Summary and Conclusions

The many outstanding questions and limitations of EPA's dioxin testing make it difficult to trust, believe, and accept the results as providing an accurate understanding of the concentration of dioxins in the surface soil in the areas of East Palestine that were impacted by the train derailment and subsequent intentional burn of vinyl chloride and other toxic chemicals. Instead, the results of the EPA testing for dioxins may reflect the unusual and unconventional methods and procedures used by Norfolk Southern to define where and how to collect samples.

Based on the data provided by EPA and the information provided to support that data and how it was collected, it is not possible to tell 1) where dioxin contamination is or isn't, or 2) what the concentrations of dioxins are at a given location. Furthermore, EPA did not disclose the actual location of any of the samples that were collected. This is an important because it is needed to evaluate and to understand the public health risks posed by the results. Without this information, it is not possible to independently evaluate and understand the public health risks posed by the dioxin contamination in East Palestine.

Surprisingly, there is no mention in the sampling plan report about addressing the public health risks posed by the contamination caused by the burning of vinyl chloride and other toxic chemicals.

Despite the many limitations in the testing approach, some sample measurements did detect significant levels of dioxins. A significant number of samples that were collected as part of EPA's dioxin sampling effort in East Palestine exceed EPA and other benchmarks and guidelines for evaluating the public health risks of dioxins and warrant additional action.

Yet, EPA has refused to conduct additional testing or take any action to address these findings. It is clear, for example, that significant concentrations of 2,3,7,8-TCDD and 2,3,4,7,8-PeCDD were found in the surface soil. Concentrations of 2,3,7,8 -TCDD were found as high as 510 ppt, more than 100 times higher than the EPA's Regional Screening Levels (RSL) for TCDD. This is a significant finding that needs to be addressed. A total of 6 samples had concentrations of 2,3,7,8-TCDD that exceeded the EPA RSL for 2,3,7,8-TCDD. In addition, 42 samples had concentrations of 1,2,3,7,8-PeCDD that exceeded the Arcadis proposed RSL for 1, 2,3,7,8-PeCDD. However, it is unclear where these samples were taken from, or even if any of the results occurred at the same location. It's important identify where these samples were collected from and to evaluate why these samples had such high concentrations. Is it a hot spot of some kind? Was there unique fallout from the smoke cloud that settled there?

Furthermore, EPA did not provide any analysis of what risks these results may pose to residents, especially if residents live on or near property with high dioxin concentrations. It's not even clear that residents who might live on or near property with high concentrations of dioxins have been informed of these findings.

Specifically, EPA needs to conduct additional testing in the areas where high levels were found in order to evaluate if these areas represent hotspots or whether there are other reasons why the concentrations of dioxins were high in these areas. A scientist appointed by the community needs to be included in this follow-up testing and investigation. It is also evident that EPA needs to take action to communicate to residents living near these sample locations.

Thus far EPA has not shared comprehensive sampling details that would allow the community and its scientific advisors to independently evaluate this sampling effort. The agency has also failed to provide transparency in its sampling and analytical procedures. Once sampling has been conducted, results have not been released in a transparent, accessible, or easy to understand manner. This unconventional approach has made it difficult to evaluate and to understand the public health risks posed by the results. Without the information, it is not possible to independently evaluate and understand the public health risks posed by the results. This has further eroded public trust in EPA's goals, data, and commitment to public health. In order to properly communicate this information to the community and instill confidence in the information, EPA must provide its sampling plans, procedures and results in a transparent and accessible manner. This has not been the case thus far.

In spite of the Norfolk Southern collecting more than 260 surface and subsurface soil samples, the people of East Palestine still have many questions about their potential exposure to dioxins. People continue to ask EPA for more testing which the agency continues to deny. Based on this analysis of the EPA's testing approach and results, additional testing is clearly needed. This additional testing should be designed to address the public health risks posed by the contamination caused by the derailment and subsequent burning of vinyl chloride and other toxic chemicals. Conducting this additional testing will go a long way towards addressing the many questions people have.

We continue to recommend that EPA conducted the following sampling for dioxins and dioxin-like substances:

- In soils at homes, parks, schools, farms, and other locations downwind of the derailment;
- In indoor dust and surfaces inside homes and other buildings downwind of the derailment;
- In farm animals, milk, and chicken eggs in farms that may be impacted by the derailment;
- In sediments, fish, salamanders (e.g., endangered Hellbender salamanders in OH), and other aquatic life including vegetation; and
- In wildlife in the area, including birds and deer, which may be hunted.

The community has given EPA ample opportunities to build trust, engage with the public, and provide information. EPA has responded with a complicated presentation of its results in which nothing is clear and little makes sense, rather than being forthcoming about its plans, processes and results. Furthermore, EPA has provided no analysis of their results.

We hope these comments are helpful. Please do not hesitate to contact us if you have any questions or require additional information.

Sincerely,

Stephen U. Lester
Science Director

Mihir Vohra
Science Fellow

EXHIBIT 21

Congress of the United States
Washington, DC 20515

October 20, 2023

The Honorable Michael S. Regan Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue,
N.W. Washington, DC 20460

Dear Administrator Regan,

We wish to express our sincere appreciation for the U.S. Environmental Protection Agency's (EPA) dedicated cleanup efforts following the Norfolk Southern train derailment in East Palestine, Ohio. While we appreciate these endeavors, we believe there's an opportunity to provide further reassurance to our constituents regarding the safety of their indoor spaces.

Numerous residents and certain experts have raised concerns about potential indoor contaminants. To prioritize the health and well-being of the East Palestine community, we suggest that the EPA ensure the availability of limited testing for compounds, including acrylate compounds and vinyl-chloride, in residences upon request, post-cleanup.

We cannot overstate the importance of transparent and proactive communication. While we recognize the EPA's perspective that vinyl-chloride and acrylate compounds may arise from ordinary household activities, it is undeniable that residents' worry about these compounds stems from the derailment. By allowing Norfolk Southern to skirt its responsibility to the community and refuse to offer this sort of testing following cleanup, the EPA risks eroding the trust of many in our community.

Should testing identify elevated levels of these compounds, we urge you to require Norfolk Southern to ensure another round of cleaning as follow-up. This seems a small price to pay for the peace of mind it would bring to our constituents. By requiring Norfolk Southern to provide this clarity and swiftly address any lingering concerns, the EPA can bolster confidence and provide much-needed reassurance to East Palestine residents.

We deeply value the EPA's unwavering commitment to environmental safety, and its support of the Ohio EPA throughout the joint response to this man-made crisis. As representatives of Ohio, we remain optimistic about a resolution that truly centers the safety and well-being of the East Palestine community.

Your prompt attention to this matter is appreciated.

Warm regards,

Sherrod Brown
United States Senator

JD Vance
United States Senator

Marcy Kaptur
United States Representative

Shontel Brown
United States Representative

Warren Davidson
United States Representative

Emelia Sykes
United States Representative

Max Miller
United States Representative

EXHIBIT 22

Community Survey Results

Research Study on Community Experiences Related to Water, Home, and Environmental Impacts after the East Palestine Chemical Spill and Fires

November 2023

Project Team

- **Dr. Lauryn Spearing**, Assistant Professor in Civil, Materials, and Environmental Engineering at the University of Illinois Chicago; Email: spearing@uic.edu
- **Mr. Joseph Toland**, Graduate Researcher at The University of Illinois Chicago
- **Dr. Andrew Whelton**, Professor of Civil Engineering and Environmental and Ecological Engineering, Purdue University
- **Dr. Clayton Wukich**, Associate Professor of Public Administration at Cleveland State University

Funding: This project is funded by the National Science Foundation under Award #2329409.

CONTENTS

PROJECT OVERVIEW

We are a team of researchers from the University of Illinois Chicago, Cleveland State University, and Purdue University who are funded by the National Science Foundation. We have spent the last few months conducting a community survey and interviews to understand people's experiences related to water, home, and air impacts after the East Palestine chemical spill and fires. The research plan has been reviewed by the Human Subjects in Research Ethics Boards at our universities (STUDY2023-0325).

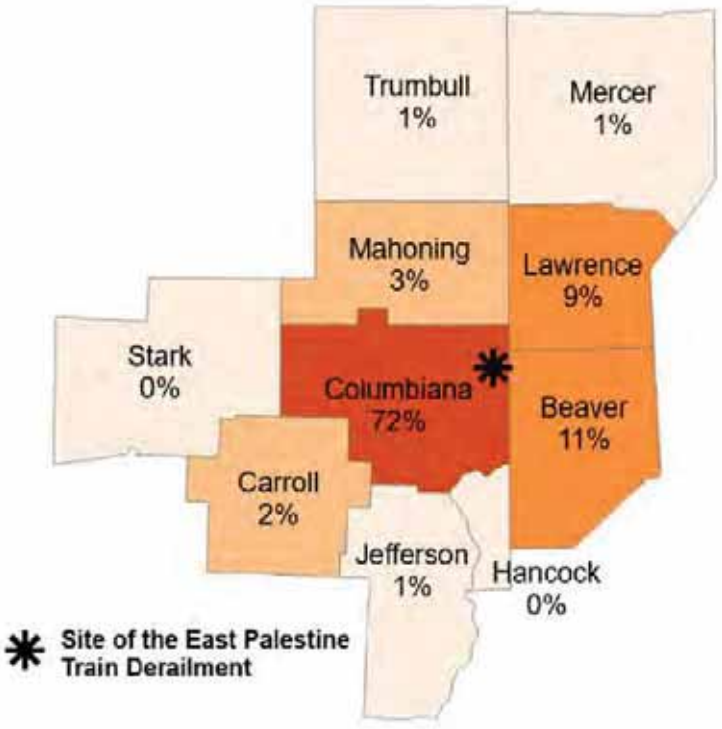
The goal of our research is to identify public attitudes about water, air, and soil safety, as well as how the crisis has impacted homes and the environment. The community survey included questions about people's experiences, including how they responded to the crisis, whether they felt there was effective communication from officials, the level of trust in test results, and from what sources they sought out information. **This research summary presents findings from the community survey, representing participating community members' perspectives.** The team is currently analyzing interview data and will present those results at a later date.

Our team visited East Palestine in March 2023 and observed a sheen in creeks that were contaminated by the chemical spill and fires.

ABOUT THE SURVEY

The community survey was open for two months, from July 20 to September 20, 2023. Community members were able to complete the survey online or by hand (either in-person or via the mail). Surveys conducted online took on average 23 minutes. To recruit participants, flyers were distributed to businesses and gathering points in the area and mailed to local residents. Participants were also recruited during public events.

To participate, people must have been 18 years or older and lived or worked in one of the counties shown in the figure below on or after February 3, 2023. **We received 256 valid survey responses.** The majority of respondents were from Columbiana County, Ohio (72%). 11% of respondents were from Beaver County, Pennsylvania and 9% were from Lawrence County, Pennsylvania. The remaining 8% of respondents were from other counties shown below. Before analyzing survey results, all identifying information was removed from the responses.



Please note that not all participants responded to each question, so the total for each question may be slightly less than 256 (the total number of responses).

WHO RESPONDED TO THE SURVEY?

45-55 YEARS
Average age of respondents

Housing and income

Most participants were homeowners (80% of respondents). 16% were renters and 6% did not answer or mention other accommodations. The median household income of respondents was between $50,000-$74,999, similar to the median household income in Columbiana, Beaver, and Lawrence Counties.

Race	Percent
White	94%
Black	2%
Native American	2%
Pacific Islander	1%
Asian	<1%

Gender	Percent
Male	31%
Female	68%
Non-Binary	1%

Age	Percent
18-24 years old	3%
25-34 years old	10%
35-44 years old	22%
45-54 years old	17%
55-64 years old	24%
65+ years old	24%

Highest Level of Education Attained	Percent
Some High School	2%
High School	13%
Some College	23%
Associates or Technical Degree	21%
Bachelor's Degree	28%
Graduate or Professional Degree	13%

WATER QUALITY PERCEPTIONS & EXPERIENCES

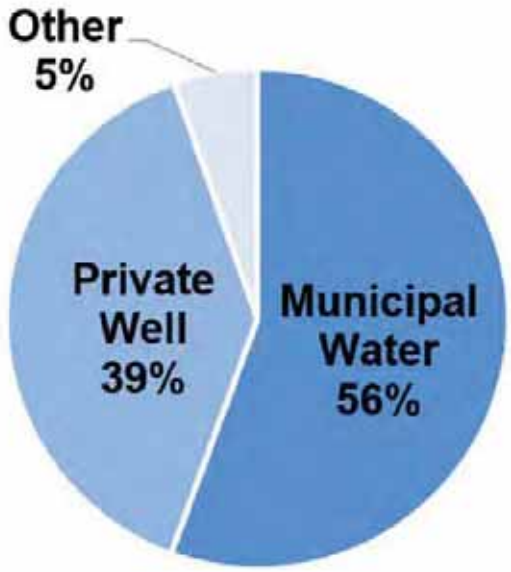
What is this section?

In this section, we asked people about how they received water at their home. We compared water sources before and after February 3, 2023. We also identified water safety concerns. This helps identify changes in water source and how people were impacted by the crisis.

Summary of results

Most households received water from municipal water supplies (56%). About 39% of households used private wells, which may also provide water for gardening, livestock, and agricultural activities in addition to household needs. After the crisis, many households purchased bottled water for drinking (69% of respondents).

Types of water service



Bottled water access after the crisis

Note: One household may have multiple sources of water.

WATER QUALITY PERCEPTIONS & EXPERIENCES

People decreased their use of municipal water by

49%

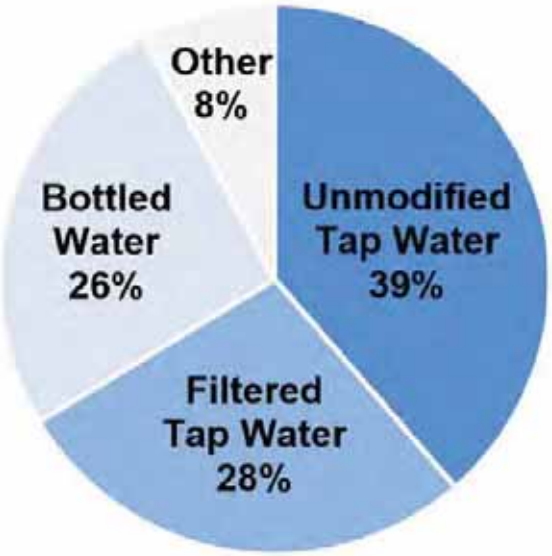
People increased their bottled water use by

92%

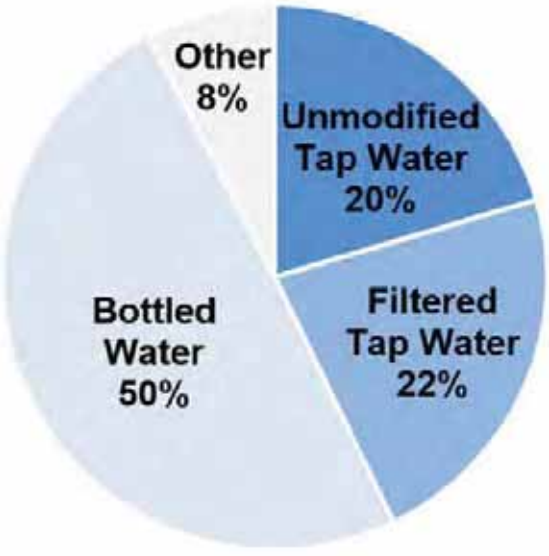
Summary of results

After the East Palestine chemical spill and fires, respondents reported a 49% decrease in use of municipal water for drinking, and a 92% increase in using bottled water for drinking.

Drinking water source <u>before</u> the crisis



Drinking water source <u>after</u> the crisis

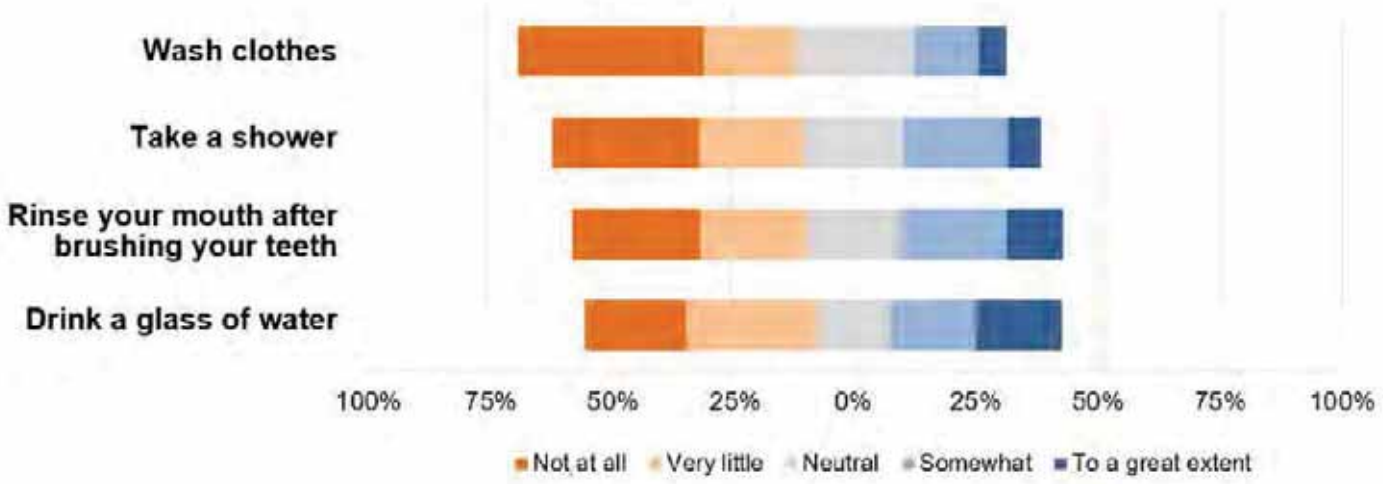


WATER QUALITY PERCEPTIONS & EXPERIENCES

Summary of results

About 10% of the respondents reported that they were told by authorities that their water was unsafe to drink. We asked about respondents' perceptions of the likelihood of getting sick. Water safety perceptions were neutral on average but 25% of the respondents reported feeling somewhat unsafe using water for basic household activities, like for drinking or brushing teeth.

People's perceived likelihood of getting sick after they...

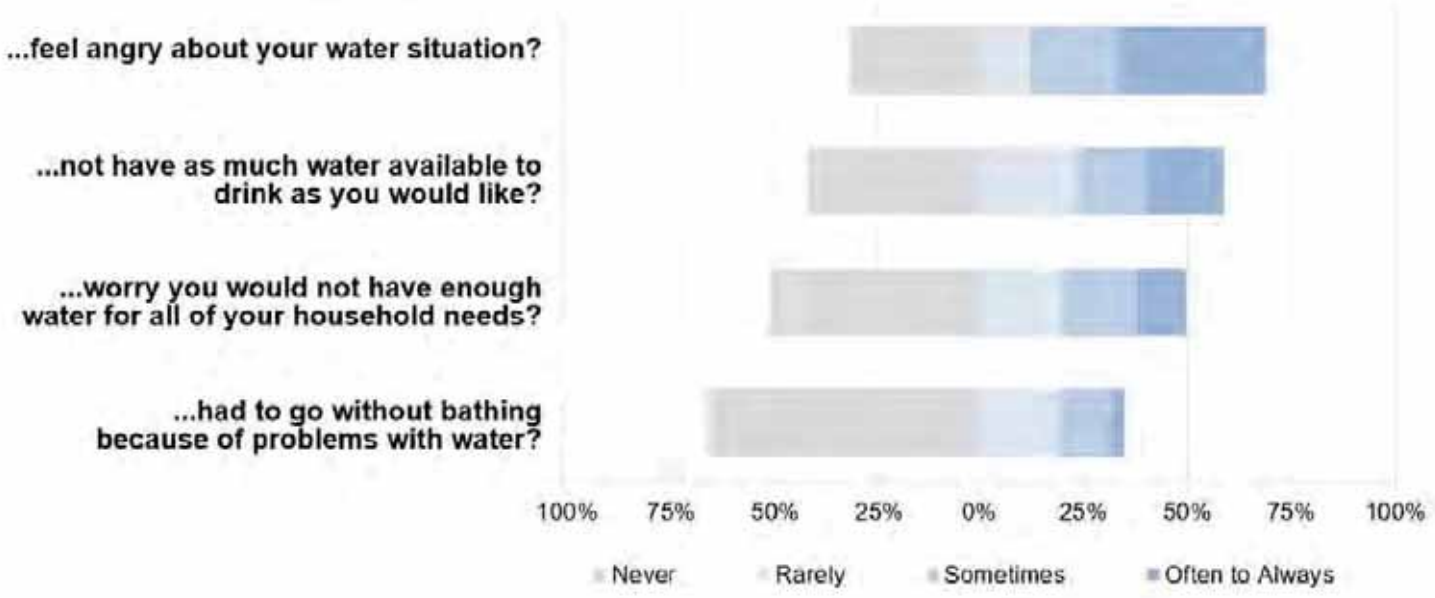


WATER INSECURITY EXPERIENCES

Summary of results

About 30% of the respondents reported experiencing household water insecurity after the East Palestine chemical spill and fires. This was determined by asking questions about how often there was no usable water for common household tasks like cooking, cleaning, bathing, or drinking during what they perceived as the most challenging month since the crisis. Other questions addressed changes in household water use and feelings about their water service.

How frequently did you or anyone in your household...



SAMPLING & TESTING

What is this section?

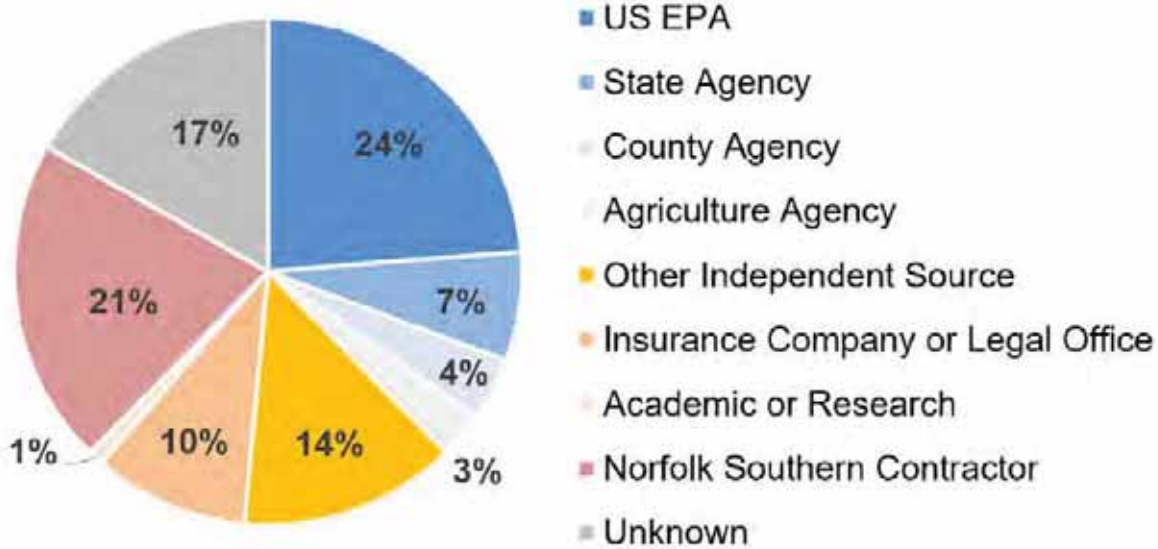
In this section we asked people about air, water, and soil sampling and testing. This included information about who requested, received, and performed testing. We also asked about trust in results and if households had trouble receiving tests or understanding results. This information can help identify needed changes in sampling procedures and communication of results.

Summary of results

Half (50%) of the participants requested air, water, or soil sampling. Of those who requested sampling, 62% received the sampling and results. Sampling and testing were mostly performed by the US Environmental Protection Agency (US EPA; 24%) and through Norfolk Southern's contractors (21%).

38% of people who requested sampling did not receive sampling and the test results

Who performed the testing received by respondents?

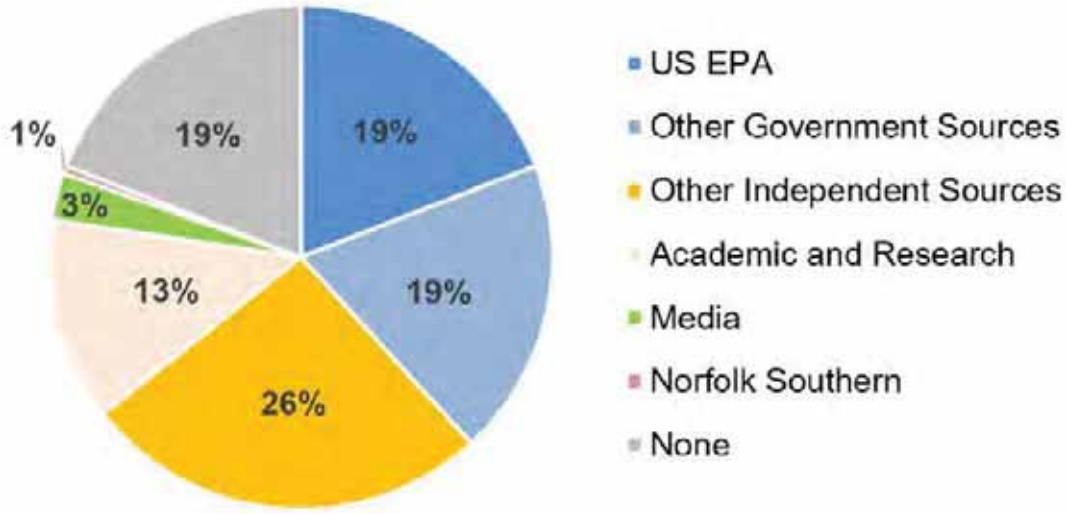


SAMPLING & TESTING

Summary of results

Many respondents identified independent sources (26%) and the US EPA (19%) as their most trusted sources for sampling and testing. However, respondents found results, in general (from across all sources) hard to understand (73%) and lacked trust in the results (75%).

Who is the most trusted source for sampling and testing?



of people who received results said **they were unclear**

of people who received results said they **did not trust** the testing

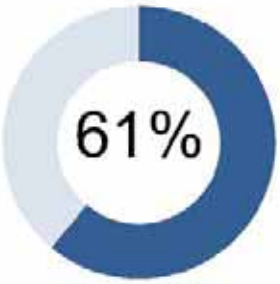
of people were **financially impacted** by paying for testing

HOUSEHOLD IMPACTS & RESPONSE

What is this section?

In this section we asked people about impacts to their home and the actions they took in response. This information helps to identify ways to better support people as they respond.

of people surveyed noticed **ash or soot on their property**



of people surveyed noticed a **new odor in their home**

Summary of results

Most respondents (82%) did not report soot or ash inside their home. However, many respondents (61%) reported a new odor within their home after the crisis.

In response, some households cleaned with a vacuum (19%) or cleaning products (16%), and used air purifiers (15%). Most cleaning was performed by the respondent rather than through assistance provided by the responsible party (1%) or the government (<1%).

Household Protective Actions	Percent
Cleaning with a vacuum	19%
Used solvents or cleaning products	16%
Used air purifiers	15%
Cleaned the exterior	7%
HEPA vacuum	7%
Used water treatment, purifiers or filters	4%
Hired cleaners	4%
Performed environmental remediation	1%
Norfolk Southern assisted cleaning	1%
Government assisted cleaning	<1%

RELOCATION & EVACUATION

What is this section?

In this section we asked people about decisions to relocate, including if they had relocated or if they wanted to relocate at the time surveyed. This information will help government agencies better support people, for example, by providing resources to those who want to relocate but have been unable to.

Summary of results

About half of the respondents (53%) reported evacuating on or after February 3, 2023. Of those participants who lived in the zip code that includes East Palestine (44413), 71% evacuated.

While most respondents (89%) identified that their current location is unchanged from February 3, 2023, 11% of people had relocated or been displaced. When surveyed, 15% of respondents were trying to relocate or had relocated because of the chemical spill and fires.

of participants evacuated during the disaster

of participants were still relocated when surveyed

47%

of participants had considered relocating, were trying to relocate, or had relocated

INFORMATION SOURCES

What is this section?

For this section, we asked people about the sources of information they used to learn about the crisis as well as how often they used each source. This information can help agencies use communication methods that match residents needs.

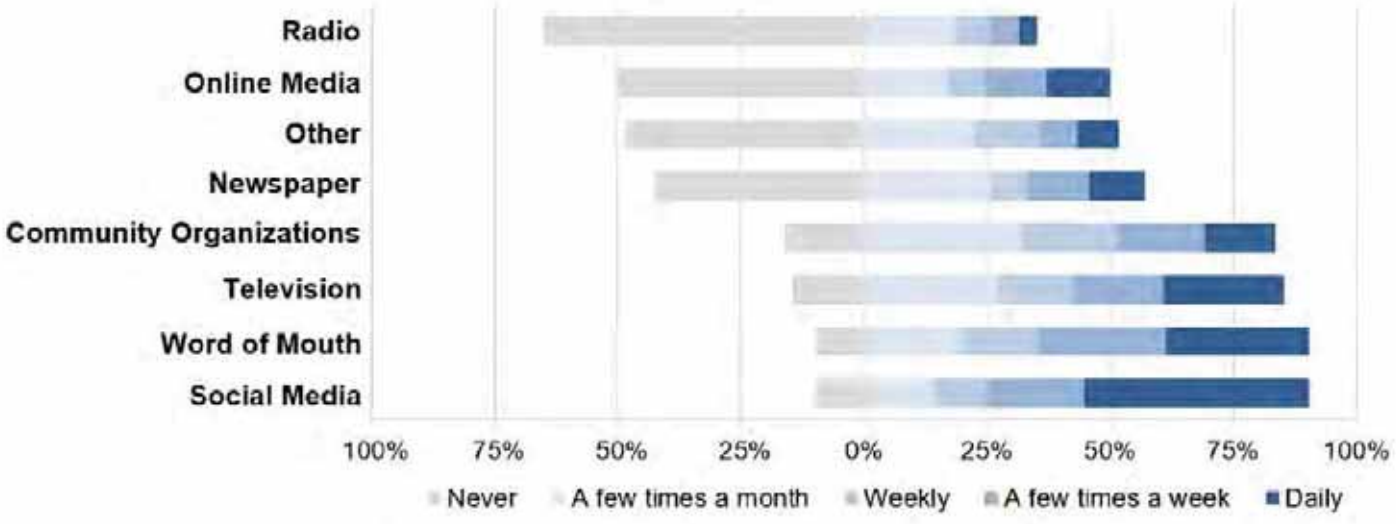
Summary of results

46% of respondents used social media daily to get information about the chemical spill and fires. Word of mouth was also important, with 29% of respondents reporting daily interactions. While social media played a large role in transmitting information, more than 50% of respondents reported a very low to low level of trust in that information (see next section for more details).

46%

of participants reported using social media daily

Information sources used by participants



INFORMATION SOURCES & TRUST

What is this section?

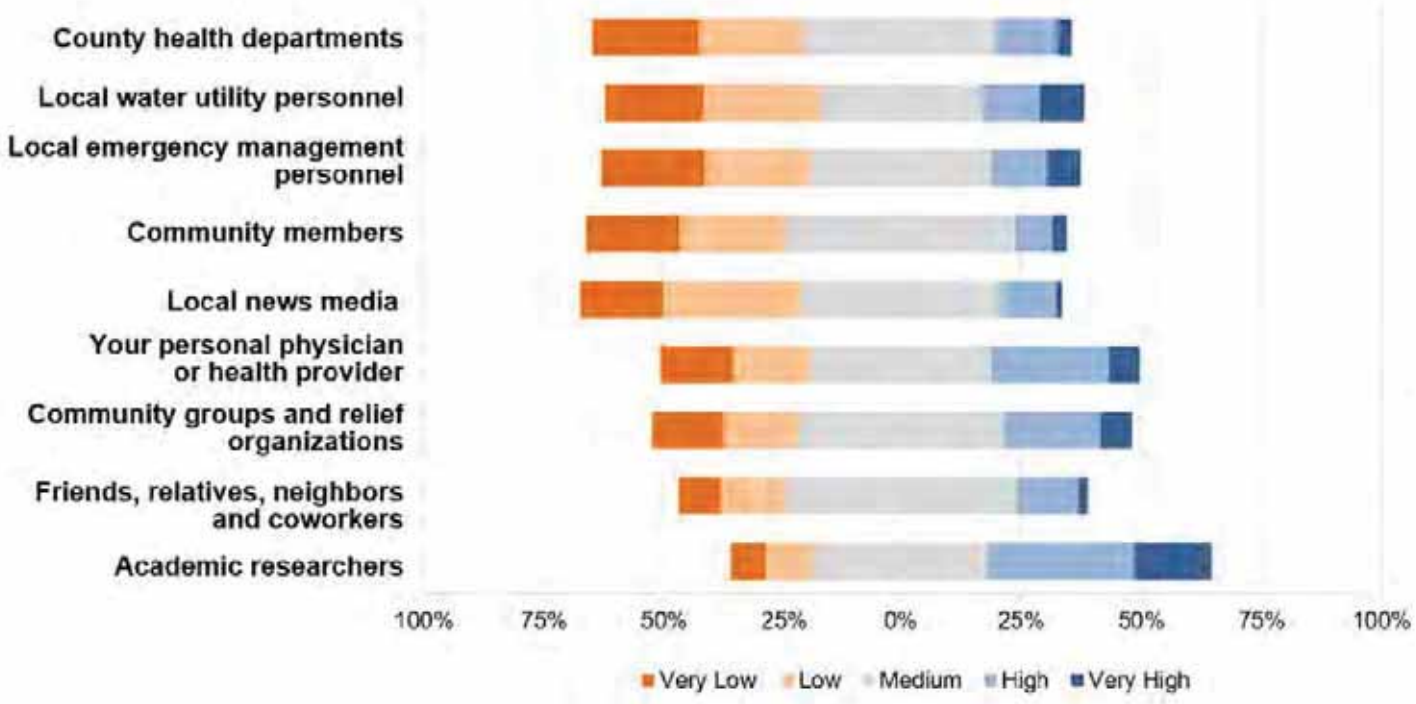
For this section, we asked people more about their sources of information. We wanted to know which information sources were trusted. This information can help organizations address communication issues.

Summary of results

The most trusted sources of information (where 25% of respondents reported at least a high level of trust) were provided by personal physicians, community groups, and academic researchers. While academic researchers were the most trusted source of information, they often have limited funding immediately post-disaster.

Academic researchers were a trusted source of information

Most trusted sources of information



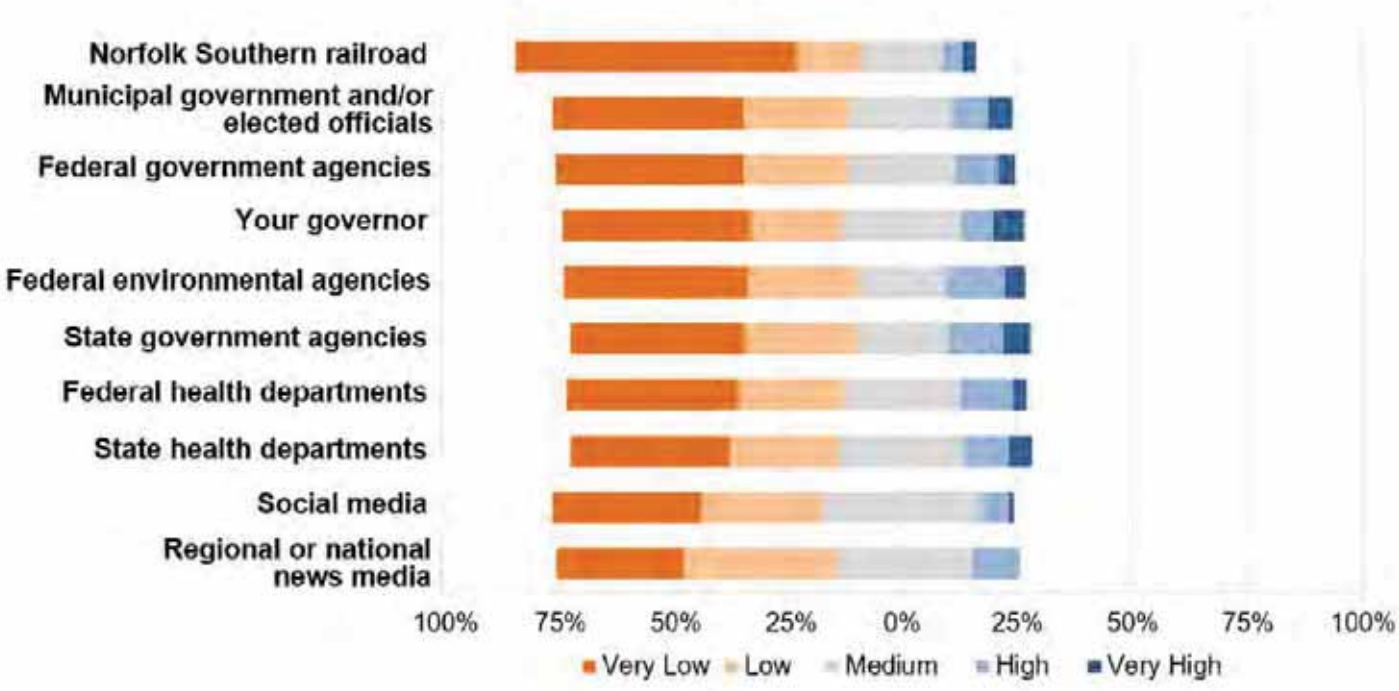
INFORMATION SOURCES &TRUST

Trust, on average, was **low**

Summary of results

The least trusted source of information (where 75% of respondents reported at most a low level of trust) was information provided by Norfolk Southern and its contractors. People also noted distrust with information provided by the government and media.

Least trusted sources of information



RISK COMMUNICATION

What is this section?

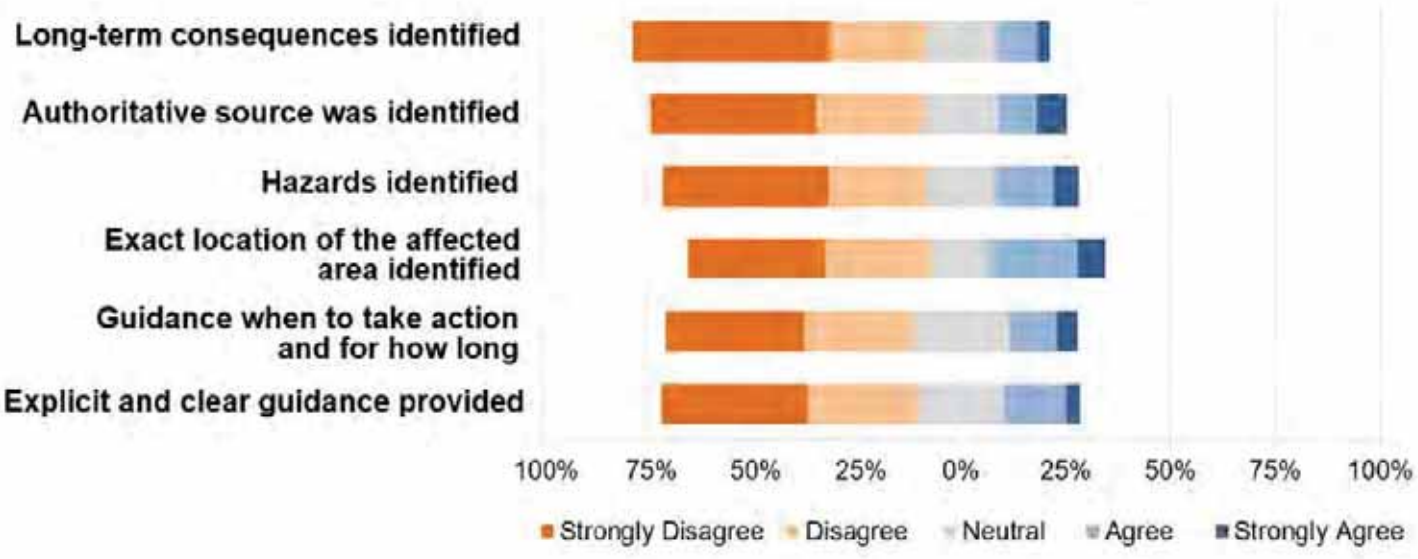
In this section we asked people about the safety information they received. Communication effectiveness was measured by the extent to which respondents perceived the official guidance addressed their questions about: 1) the specific risks involved; 2) the location of impact; 3) specific safety guidance; 4) the timing for these recommended actions; and 5) whether an authoritative source was cited.

This information helps to determine whether the official messaging included information for the public to make informed decisions.

Summary of results

Respondents indicated low effectiveness in risk messaging. More than 50% of respondents disagreed that risk communications were effective by any of the measures used.

Perceived effectiveness of risk communication



EXPERT KNOWLEDGE

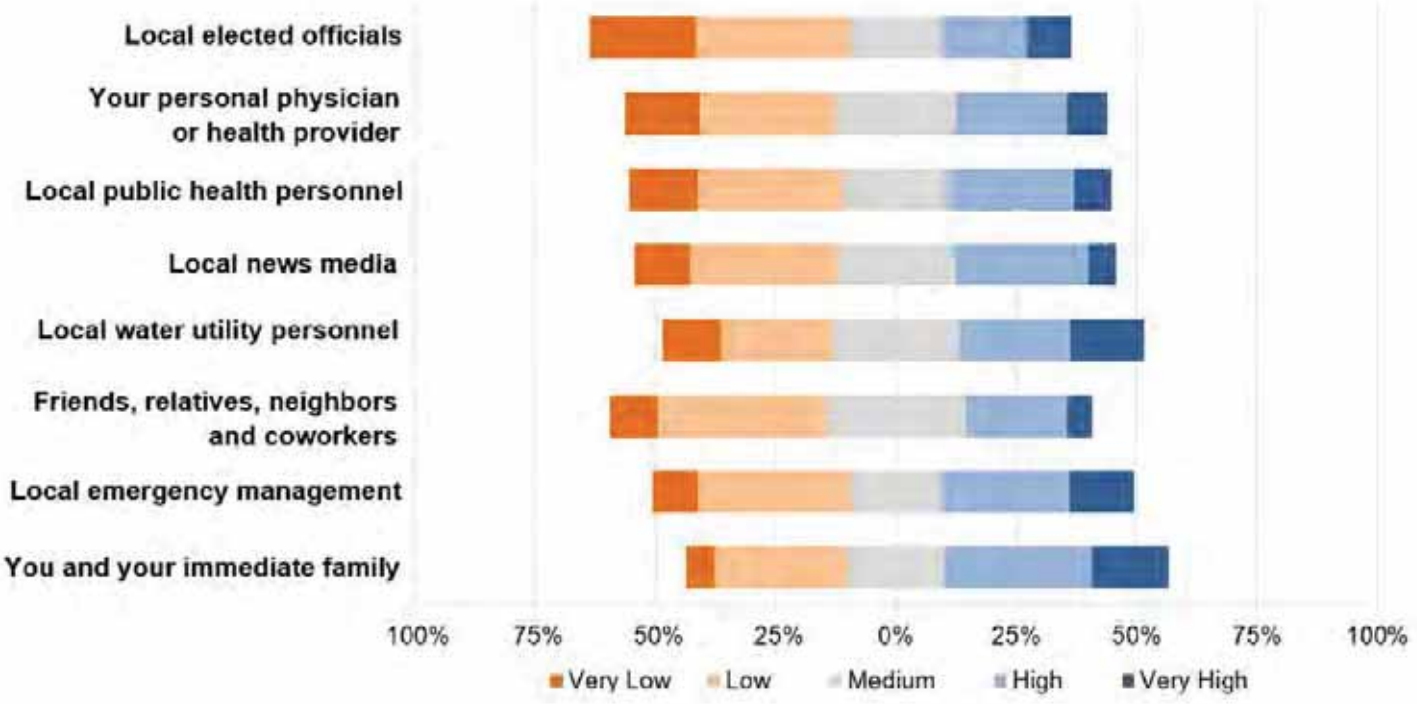
What is this section?

In this section we asked people about who they perceived as experts regarding the crisis. This information reveals where people think there are knowledge gaps.

Summary of results

Respondents rated expert knowledge higher than average. Despite that trend, respondents indicated, on average, that there was a low effectiveness in risk messaging (see previous page). This suggests that respondents think the problem it is not necessarily a lack of knowledge alone—but the effectiveness in communicating risk and seeking out the correct testing methods.

Who has expert knowledge about the crisis?



COMMUNITY ENGAGEMENT

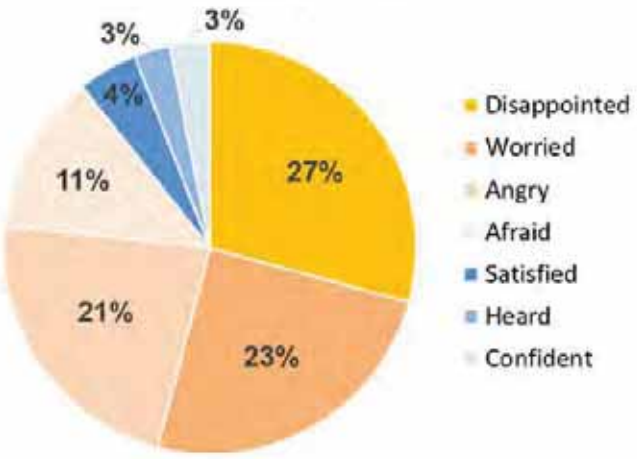
What is this section?

In this section we asked people about community engagement and how they perceived equity and fairness in the crisis response. This information helps us to understand ways to improve community engagement.

Summary of results

Half of the respondents (50%) attended community meetings, and of those that attended, disappointment (27%) and worry (23%) were the most common reactions. Equity and fairness were rated low, on average, in the community. Only 25% of respondents rated fairness, transparency, and equity as neutral or higher.

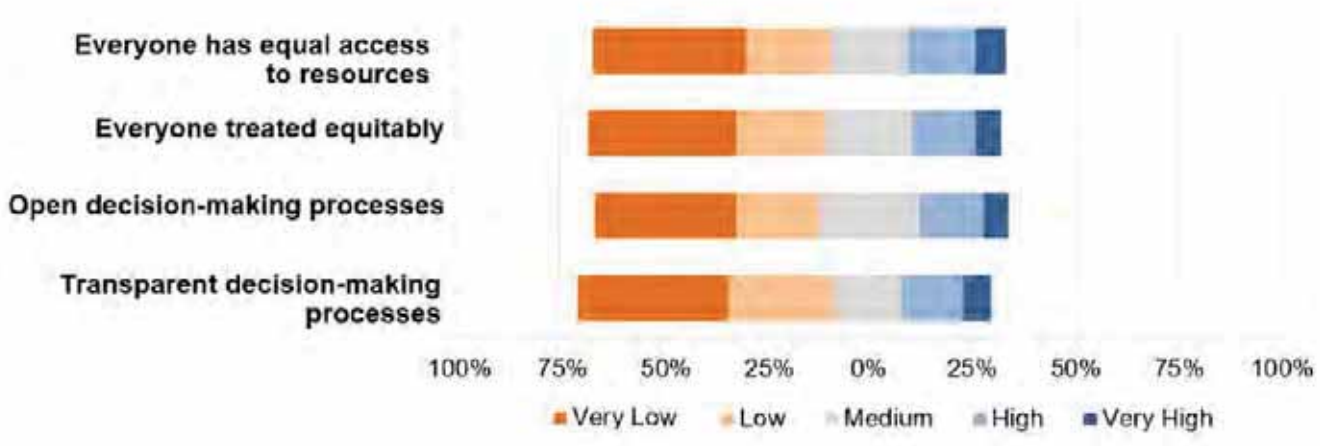
Community meeting reactions



50% attended a community meeting

15% gave oral or written comments

Perceptions about equity and fairness



Note: One respondent may have multiple reactions. Other (8%) omitted.

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RECOMMENDATIONS

Water, air, and soil testing to meet community needs

Key Findings: Many participants requested air, water, or soil sampling services, but did not receive them. Other respondents had sampling performed but did not receive testing results. In turn, citizens sought out independent testing, often at a cost. Even those respondents who received sampling services and results often lacked trust in the results or struggled to understand what the results meant for their safety.

Recommendation to support impacted residents: There is still a gap in water, air, and soil safety knowledge in East Palestine and surrounding areas. The survey was conducted approximately six months after the crisis, yet many households were still unsure if water, air, and soil was safe in the area. Increased testing could help to resolve community concerns about lacking adequate safety information to inform decision-making. For example, long-term testing of ground water near the impacted water sources (including household well water) may help address concerns about drinking water safety over time.

Recommendation to improve response to future disasters: Develop and make publicly available sample, collection, and test result sharing protocols that are standardized and consistent across responding agencies. Sampling must be timely, and households should have a clear way to request sampling. People concerned with their safety should be treated equitably and fairly and also have access to understandable, clear information about data collection processes (such as sampling plans) and test results from responding agencies.

RECOMMENDATIONS

Effective communication of risk

Key Findings: Gaps in effective communication by responding agencies were noted in the survey responses. Many people lacked trust in the information provided by responding agencies. Key questions were left unanswered, creating uncertainty as to how households should respond.

Recommendation to support impacted residents: There is a need to clearly communicate long-term environmental risks to community members. Environmental sampling results should be shared in a clear and accessible manner. To help align risk information with community questions, community groups, who were identified as a trusted source of information, could be regularly consulted by agencies.

Recommendation to improve response to future disasters: There is a need for guidelines and resources to aid in communicating complex scientific information to the public. This might include frameworks for developing sampling plans, methods used for testing, and explaining limitations of those methods. Standard templates for communicating water, air, and soil sampling results to community members could help to improve response to future disasters.

RECOMMENDATIONS

Improved human services delivery

Key Findings: This environmental crisis did not affect all households in the same way. Some community members were concerned about long-term impacts to their private water source, such as wells. Others permanently relocated or were thinking about doing so. There were concerns that recovery services were not delivered in an equitable and fair manner, such as who was reimbursed for relocation expenses and who received air, water, or soil testing. Additionally, our findings show that residents beyond the evacuation area noticed smells in their homes post-crisis and noted concerns about safety.

Recommendation to support impacted residents: There are many community needs and concerns that have not been addressed, such as indoor safety assessments. For example, home and office cleaning offered to residents could include air and surface testing post-cleaning to provide residents with critical information about their building's safety. The "cleaning area of operation" does not include some respondents that reported smells inside their buildings. To address indoor air safety concerns, the cleaning services could be offered to people residing outside of the "area of operation".

Recommendation to improve response to future disasters: Redefine the role of the "responsible party" (e.g., Norfolk Southern) during environmental crises. A neutral, third-party agency, like the Department of Health and Human Services or the Federal Emergency Management Agency, could lead the coordination of household eligibility determination for access to emergency resources. Criteria for determining who receives human services and what they receive could improve fairness and transparency.

ACKNOWLEDGMENTS

- Thank you to everyone who participated. We appreciate you taking the time to complete the survey or an interview.
- Thank you to community groups and leaders that have helped to support this work and spread the word about the survey.
- Thank you to our advisory board comprised of researchers and community leaders for their time spent reviewing the survey and report.
- This work is supported by the National Science Foundation under Award #2329409.

CONTACT & WEBSITE

If you have questions about the survey or our research please contact:

Dr. Lauryn Spearing
Email: spearing@uic.edu
Phone: (312) 996-9416

We will continue to provide research updates on our project website:

https://sites.google.com/uic.edu/east-palestine-crisis/

EXHIBIT 23

OFFICE OF GENERAL COUNSEL
WASHINGTON, D.C. 20460

11/02/2023

Lesley Pacey
Environmental Investigator
Government Accountability Project
[redacted]

Re: Freedom of Information Act Request – 2024-R05-02354
Expedited Processing Determination

Dear Lesley Pacey:

This letter concerns the above-referenced Freedom of Information Act (FOIA) request, received by the U.S. Environmental Protection Agency (EPA), National FOIA Office (NFO) on 10/23/2023 in which you are seeking:

> "Freedom of Information Act Request. On behalf of the Government Accountability Project, I hereby request the following records related to the February 3, 2023 East Palestine train derailment and its aftermath:
>
> 1. All lists of any chemicals that were spilled and/or ignited as a result of the derailment and/or controlled burn, including quantities of each chemical that was spilled and/or ignited. As an alternative to producing all such lists, EPA may satisfy this item of the request by producing records sufficient to show every chemical that was spilled and/or ignited as a result of the derailment and/or controlled burn and the quantity of each such chemical.
>
> 2. All test results, sampling data, lab reports, videos of testing, lab data, and quality assurance/quality control data resulting from sampling tests of dioxin or dioxin-related compounds in the air, soil, water, homes, or businesses following the derailment. Please include such records for testing conducted by EPA, Norfolk Southern, the Center for Toxicology and Environmental Health, Arcadis, and/or any other entity that performed such testing.
>
> 3. All emails referring to the independent sampling and/or testing of dioxins or dioxin-related compounds conducted by Scott Smith. Please search all custodians reasonably likely to possess responsive records. Without limiting this item of the request, those custodians might include Mark Durno.
>
> 4. All test results, sampling data, lab reports, lab data, and quality assurance/quality control data

resulting from sampling tests of acrolein or acrolein-related compounds in the air, soil, water, homes, or businesses following the derailment. Please include such records for testing conducted by EPA, Norfolk Southern, the Center for Toxicology and Environmental Health, and/or any other entity that performed such testing. (Date Range for Record Search: From 02/03/2023 To 10/23/2023)".

EPA has received your request for expedited processing. In your justification, you asserted the following:

"There is a compelling need for expedited processing of each part of this request. That is both because 'the lack of expedited treatment could reasonably be expected to pose an imminent threat to the life or physical safety of an individual,' and there exists '[a]n urgency to inform the public about an actual or alleged Federal government activity, if the information is requested by a person primarily engaged in disseminating information to the public.' 40 C.F.R. § 2.104(f). *See also* 5 U.S.C. § 552(a)(6)(E)(v).

1. Life or Physical Safety

EPA has publicly stated that East Palestine residents are safe from chemicals that entered the environment after the February derailment.[1] Residents are presumably relying on this representation to make medical choices, decide whether to relocate, and generally plan their lives.

Whether or not EPA is right about the current safety of East Palestine, residents continue to suffer from a long list of symptoms with which they became afflicted immediately after the derailment. Here is a non-exhaustive list of such symptoms gathered from my personal interviews with East Palestine residents in late September and early October:

- Heavy menstruation followed by a complete halt to menstruation;
- Uterine nodules;
- Seizures;
- Recurrent headaches;
- Dizziness;
- Insomnia;
- Constant fatigue;
- Coughing up blood;
- Bleeding out ears;
- Earaches;
- Numb extremities;
- Tingling and numbness in lips;
- Severe toothaches;
- Tooth decay;
- Lost teeth;
- Hypertension;
- Nausea;

[1] https://www.epa.gov/east-palestine-oh-train-derailment/home-and-office-cleaning#:~:text=Air%20monitor%20and%20sampling%20in,concern%20for%20incident%20specific%20chemicals.

- Diarrhea;
- Muscle aches;
- Hair falling out;
- Involuntary curling of hands;
- Chemical bronchitis.

These symptoms are not limited to residents. According to further news reports, seven CDC investigators contracted several of these symptoms on a temporary visit to East Palestine, and those symptoms disappeared soon after they left the area.[2]

Medical professionals have recognized that treating these current and severe symptoms requires understanding their causes. Dr. Erin Haynes, a professor of preventive medicine and environmental health at the University of Kentucky, stated in late February that it is unknown when East Palestine would become safe again, and that understanding this requires the results of 'research to determine what types of chemicals formed during the burn and how people can be exposed to them.'[3] Whether or not East Palestine is currently safe, it is imperative for medical professionals to have a complete list of the chemicals to which the residents might have been exposed at some point (***Item 1 of the request***). Concentrations of those chemicals are also essential so that providers can understand which chemicals are present in high enough doses to cause illness and thus perform a differential diagnosis. And the prospect of synergistic toxicity augments the need for this information: if certain symptoms are caused by the synergistic effects of several toxins, diagnosis is all but impossible without knowing the full set of toxins present.

There is also substantial evidence of unsafe levels of certain chemicals, which contradicts EPA's conclusion that East Palestine is a safe place to live. Two types of chemicals are of particular concern.

The first are dioxins. Notwithstanding EPA's claims, independent analyst Scott Smith has tested dioxins at concentrations of 20-30 ppt (using the TEQ value), results reached in over 30% of his samples.[4] This concentration represents 300-400% of the accepted background residential dioxin level.[5] Thus, whether unacceptable dioxin levels exist in East Palestine depends entirely on whether EPA's or Mr. Smith's data is more valid and/or representative of actual dioxin concentrations in East Palestine. Because of this, it is imperative that the public understand how EPA tested for dioxins in East Palestine (***Item 2 of the request***) and how it analyzed and reacted to Mr. Smith's findings (***Item 3 of the request***). If Mr. Smith's testing is more accurate, residents will need to take additional precautions to protect themselves against potentially carcinogenic exposures and possibly also get screened for dioxin-induced cancer. In addition, getting this right is particularly important given the effects of synergistic toxicity.

Further, at least some of the discrepancy between EPA's and Mr. Smith's results appears to stem

[2] https://www.cnn.com/2023/03/31/health/ohio-train-derailment-cdc-team-symptoms/index.html.
[3] https://uknow.uky.edu/research/qa-environmental-health-scientist-erin-haynes-potential-impacts-east-palestine-disaster.
[4] https://www.cleveland19.com/2023/10/04/east-palestine-residents-given-green-light-garden-epa-releases-soil-results-heels-lawsuit-filed-against-them/
[5] https://semspub.epa.gov/work/06/100001681.pdf.

from their testing in different locations.[6] If so, it is imperative that residents understand the limitations of EPA's testing so that they can take precautions to avoid imminently dangerous parts of East Palestine.

The second chemical of concern is acrolein. As reported in a September 25, 2023 memorandum, EPA OIG 'noted multiple instances in the air monitoring and sampling data on the EPA's East Palestine website,, including ... [e]xceedances and missing data on the concentrations and public health impact of acrolein, a hazardous air pollutant that was presumably created by the burning of other chemicals during the incident.'[7] Similarly, researchers from Carnegie Mellon and Texas A&M confirmed the detection of "some levels [of acrolein] substantially above long-term health thresholds," and noted that high levels of acrolein can cause symptoms including eye watering, burning of the nose and throat, decreased breathing rates, and 'pathological lesions and nasal tumors with long-term chronic exposure.'[8] Given these findings, the public urgently requires more information about EPA's acrolein testing (***Item 4 of the request***) to determine what action to take in response to their ongoing exposure to this dangerous chemical.

2. Urgency to Inform the Public

There is an urgency to inform the public for all the reasons just given. In addition, there is an urgent need for the public, including environmental scientists, medical professionals, and public health experts to weigh in on the adequacy of EPA's chemical testing and the accuracy of its representation that East Palestine is a safe place to live. Depending on the outcome of that public discussion, EPA, other government entities, and East Palestine residents may need to change their responses to the ongoing situation. These changes might come too late if the request is not expedited because of the ongoing harms residents may be suffering at the hands of dangerous chemical exposures.

Finally, as discussed above in the section on fee waivers, GAP is primarily engaged in the dissemination of information. That section is hereby incorporated by reference."

Analysis

Your request for expedited processing must be evaluated under 40 C.F.R. § 2.104(f) which reads as follows:

(f) ***Expedited processing.***

(1) EPA will take requests or appeals out of order and give expedited treatment whenever EPA determines that such requests or appeals involve a compelling need, as follows:

(i) Circumstances in which the lack of expedited treatment could reasonably be expected to pose an imminent threat to the life or physical safety of an individual; or

(ii) An urgency to inform the public about an actual or alleged Federal government activity, if the information is requested by a person primarily engaged in disseminating information to the public.

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[6] https://www.cleveland19.com/2023/10/04/east-palestine-residents-given-green-light-garden-epa-releases-soil-results-heels-lawsuit-filed-against-them/

[7] https://www.epaoig.gov/sites/default/files/document/2023-09/oig_east_palestine_status_memo.pdf.

[8] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10413936/.

Imminent Threat to Life or Physical Safety - 40 C.F.R. § 2.104(f)(1)(i)

You have alleged that a lack of expedited treatment of each specific part of your request would reasonably be expected to pose an imminent threat to the life or safety of individuals. You assert that residents are suffering from "symptoms with which they became afflicted immediately after the derailment," and you provide a non-exhaustive list of symptoms. You allege that information responsive to Part 1 of your request is urgently needed to assist medical providers and researchers with treating these symptoms. You allege that Parts 2, 3, and 4 of your request will inform the public regarding EPA's testing for dioxins and other chemicals in East Palestine, how EPA's testing compares to that of independent analyst, Scott Smith, and whether statements EPA has made regarding the safety of East Palestine are accurate. You assert that information responsive to these parts of your request is therefore urgently needed so that residents can make informed health decisions and avoid danger.

Urgency to Inform the Public - 40 C.F.R. § 2.104(f)(1)(ii)

Additionally, you have alleged that there is an urgency to inform the public about an actual or alleged federal government activity, and that GAP is primarily engaged in disseminating information to the public.

Conclusion

Following careful review of the record and the arguments presented therein, I find that your request provides a sufficient level of detail to support your application. Specifically, while EPA does not endorse your position that there is an imminent threat to the life or safety of the East Palestine residents, you have demonstrated that a lack of expedited treatment could potentially reasonably be expected to pose an imminent threat to the life or safety of individuals in East Palestine. You address how each part of your request meets this standard, and your request is specifically tailored to the information that you have alleged needs expedited processing. Because EPA finds that you have satisfied 40 C.F.R. § 2.104(f)(1)(i) there is no need to determine whether GAP satisfies 40 C.F.R. § 2.104(f)(1)(ii). Therefore, your request for expedited processing is granted. Accordingly, the EPA will take this request out of order and provide expedited treatment to process the FOIA request.[9]

You may appeal this determination by email at hq.foia@epa.gov, or by mail to the EPA's National FOIA Office, U.S. EPA, 1200 Pennsylvania Avenue, N.W. (2310A), Washington, DC 20460 or through FOIAXpress if you are an account holder. If you are submitting your appeal by hand delivery, courier service, or overnight delivery, you must address your correspondence to 1200 Pennsylvania Avenue, N.W., WJC-N Building, Room 7309C, Washington, DC 20460.

Your appeal must be in writing, and it must be received no later than 90 calendar days from the date of this letter. The Agency will not consider appeals *received* after the 90-calendar-day limit. Appeals received after 5:00 p.m. EST will be considered received the next business day. The appeal letter should include the FOIA tracking number listed above. For quickest possible handling, the subject line of your

[9] Note that EPA's decision regarding this application for expedited processing is limited to this request specifically. Requests are evaluated on a case-by-case basis, and decisions regarding expedited processing are made based on information explicitly provided in the request. A grant of expedited processing to a requester in one instance does not affect how a future request might be evaluated.

email, the appeal letter, and its envelope, if applicable, should be marked "Freedom of Information Act Appeal."

If you need any further assistance or would like to discuss any aspect of your request, you may seek assistance from EPA's FOIA Public Liaison at hq.foia@epa.gov or call (202) 566-1667. You may also seek assistance from the Office of Government Information Services (OGIS). You may contact OGIS in any of the following ways: by mail, Office of Government Information Services, National Archives and Records Administration, 8601 Adelphi Road, College Park, MD 20740-6001; email: ogis@nara.gov; telephone: (202) 741-5770 or (877) 684-6448; or fax: (202) 741-5769. For all media inquiries, please contact press@epa.gov.

Sincerely,

Kevin W. Hill
Attorney-Adviser
National FOIA Office

EXHIBIT 24

Unity Council

East Palestine Justice

November 3, 2023

Open Letter to the Village of East Palestine, OH

The Unity Council for the East Palestine Train Derailment writes this letter in solidarity with East Palestine Justice to clarify issues and concerns of the residents of East Palestine, OH and surrounding impacted communities. It has been **NINE MONTHS** since a Norfolk Southern train carrying carcinogenic chemicals derailed in our community and now is time for answers and transparency from our local officials. Answers to the lingering questions the community has would help residents move forward and trust in the future transparency of our local government.

- Why was the evacuation area changed from James Street crossing the night of the derailment to .6 miles closer to the PA border in days to follow?
- How many new positions were created in the village by funds received from NS and who occupies those positions? How were the new hires chosen? What was NS' involvement in the process? Is the full list of candidates and job posting for each position available?
- Do you have a full list of purchases made towards the needs of the community by the NS Community Liaison?
- What is the total amount of money the city has received from NS to date? Can we see a detailed list of donations to the school, school organizations, Fire Dept. etc.
- Did current city employees get raises after the derailment?
- Is the Village supporting any efforts to ensure safety of impacted residents in neighboring communities including Pennsylvania? If not, who is representing those communities unmet needs, as the Disaster declaration by President Biden dictates any federal support they will receive?
- When did the municipal building have the pipe capped to prevent vapor intrusion? Was this made public? If not, why? If so, by what means?
- What data is the mayor using to report the percentage of residents who want to "move on" vs. the percentage who still have concerns?
- Who met or is meeting with FEMA coordinator McPherson? Who is involved in writing his report to the President? How are the unmet needs of residents being assessed? Is the village addressing all concerns or just the economic recovery concerns of some? Will the Village hold a community meeting with the FEMA coordinator to address unmet needs that are representative of residents?
- Why did the village fail to respond to the EPA when Debra Shore said they are not seeing a pathway to vapor intrusion when the village is well aware of the situation with sewer pipes, storm drains, businesses having merchandise deemed contaminated (due to indoor air) and basements with creek water coming into them? (Not one single village official has asked to see the videos they have known about since Feb. 15. which shows a potential pathway to exposure inside a home and verified by CTEH.)
- What is the current relationship between our police officers and NS. It can be seen they are working for NS. What is the hourly wage? Is this part of their duties with the city? Are they also the same officers deciding which residents to prosecute? Were the village police told , as other officers were told, to not mess with the trucks coming out of ground zero?
- Did government officials ever visit the NS assistance center? Ask for their guidelines on reimbursement? Address residents' concerns?
- What is the current relationship of the fire department and NS? The school and NS? Is the school and fire department administration telling their employees they can not address or speak of concerns? Is the village council and the Mayor being told they can not speak their truth?
- What has the village done to ensure human health issues are being addressed? Do they have a toxicologist to consult with? Do they know of current issues with the clinic in town as well as primary care physicians in the area?

For more information on the current health issues and struggles in East Palestine Oh, please follow our facebook "Unity Council for the East Palestine Train Derailment"

Unity Council

East Palestine Justice

If so, how did the village not address Debra Shore telling residents to go to their doctors, who have no understanding of chemical exposure, if they were still experiencing chemical related illnesses?. Is the village working with any of the doctors doing studies in East Palestine or to ensure future medical needs are addressed?

- Residents were told by the EPA that the village received a government grant to hire an independent scientist. How was this person chosen? Do they have any results? Why is this person and process not transparent to residents? Why does the village refuse to speak with experts from across the country?
- Why did the Mayor fail to publicly announce the uptick in seizures he was seeing but instead chose to disclose the information in private asking that it not be made public? Are their other health issues being seen that residents are not being told about? Why did the village not want to share information when it comes to public health?
- Why does the police chief refuse to return resident calls? There are legit concerns that are not being addressed in regards to our city police officers.
- Why does the village fail to correct when the President and press state that the President ordered EPA, FEMA, and the CDC to go door to door and check on residents. Did anyone from the village go door to door to check on residents?
- Why are village meetings with politicians and other government administrators always closed doors with only those focused on economic recovery present? Why are residents with ongoing health concerns being blocked from access to speak? (The blame was put on the village as the ones hosting these meetings and inviting people to them.)
- How was the business owner chosen to testify at the now canceled Field Hearing that was to be held in EP on Sept. 22nd? Were the persons in charge aware of his recent business transaction with NS? If so, explain how that is not a conflict of interest?
- Why did village officials choose ***not to attend*** EPA and CDC meetings? Why did they feel that it was not necessary to obtain all the information they could and listen to resident concerns? Why did they feel it was not necessary to support residents when the CDC said that we have **ALL** been exposed to vinyl chloride? Such irony that the CDC doesn't know what to do about chemical exposure but they know how to treat cancers that chemicals cause?
- Why are the village officials argumentative with residents who want answers instead of supporting them?
- Is the city pursuing legal action against NS? If not, why?
- Does the village currently have an updated emergency response plan? Was one in place on Feb. 3? If so, when was it last updated?
- Does the village have a speed limit from trains carrying hazardous materials through the village? If so, what is the limit and how is it enforced?

Please respond swiftly as these concerns are immediate and pressing to human health. **We would appreciate a reply by November 13th.** Let's not forget every gallon of contaminated water removed and every ounce of contaminated soil removed from ground zero were contamination left in our community by NS. They covered it up and prepared to roll out. Without questions, we would all still be living here none the wiser.

"The key to wisdom is this – constant and frequent questioning, for by doubting we are led to question, by questioning we arrive at the truth." – Peter Abelard

Thank you,

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For more information on the current health issues and struggles in East Palestine Oh, please follow our facebook "Unity Council for the East Palestine Train Derailment"

EXHIBIT 25

December 11, 2023

Dear President Biden,

I write to you today not as the head of government, not as the director of the executive branch, not as the commander-in-chief of the US armed forces, but as a child, a parent, a grandparent, a spouse, a human. As I searched my mind for all the things I could say to you as an impacted resident of East Palestine, OH, my head spins.

Since the Norfolk Southern train derailment and subsequent unnecessary, illegal, open burn of five tankers of vinyl chloride in our community on February 3, 2023, there is so much I could say. I could speak on the unmet needs of residents, the children still having health symptoms, being forced to live in untested homes, the lack of medical knowledge on chemical exposures, the still heavily contaminated creeks, the lack of assistance to PA residents, economic recovery being prioritized over human health or how our local, state and federal government has blocked the voices of the people, BUT I choose to speak on the things we lost that mean the most, the things that cannot be replaced, the things money can't buy.

See, the truth is Norfolk Southern can never make it right because the most valuable losses suffered were not monetary. When you hear the CDC tell you: "There is no way to get rid of vinyl chloride from the body. There is no way to get rid of dioxins from the body. The key to a healthy East Palestine will be early detection of any health issues, especially cancers. We may not know how to treat or get rid of vinyl chloride from the body, but we know how to treat those cancers", your world changes. You realize that statement is not just about you but about your child, your husband, your mother, your nieces, and everyone you have ever known or loved. You start to think about what is important in life, what your future looks like, the challenges you will face, the challenges your children will face, and the challenges future generations will face due to the negligence of corporate greed and the failures of your government. You realize our greatest losses were the loss of our sense of safety, our family's health, our faith in humanity, and faith in our government.

We can no longer feel safe letting our kids catch crawdads in the creek, go swimming in the local water hole, or eat the bounty from a long day of fishing. We can no longer see a long, happy life for everyone in our families as the reality is, we will lose some to early cancer. We no longer have faith that our government will do the right thing and value human life over material things, to protect our health in a disaster, or even to represent us. The train may not have instantly killed people but that does not mean people will not die a slow death from the chemical exposure. It does not mean the train did not kill hopes, dreams, families, financial stability, and people's lives.

We ask you to remove politics from the situation and lead with compassion from your heart. We are calling on our President to meet with us, to hear our cries, to sign off on getting all impacted communities the federal support they need and deserve as United States citizens. To relocate impacted residents until their homes and soil are properly tested, to provide us with a pathway to proper health care in the present and future. We ask you to make good on your promises to visit East Palestine and to provide us with anything we need. We implore you to meet with residents ***that are truly representative*** of our suffering communities and hear the truth. You can listen to the stories skewed by politics and economic recovery, but we plead for you to listen to the people fighting for their families on the ground, of parent's that face the same exact fears you had when

your son was exposed to chemical burn pits, of parent's that may have to go through the same unbearable hurt and grief that you had to endure with your beloved son.

This is not a red issue or a blue issue, this is an issue of human lives. This could happen to any community no matter what their political views. As taxpayers, we would want our tax dollars to go to communities suffering like ours. We understand there is a responsible party, but the government should bear the burden of recouping losses from Norfolk Southern. We, the citizens, cannot afford to take on that burden when the cost is human health. The time was then. It has been ten months, and we cannot have our right to clean air, water, and soil denied anymore. Our lives depend on it, our children's lives depend on it.

Thank you,

Jami R. Wallace

Jami R. Wallace, J.D., M.P.A.

EXHIBIT 26

Public Health Research and Surveillance Priorities from the East Palestine Train Derailment: Proceedings of a Workshop in Brief (2024)

DETAILS

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Proceedings of a Workshop—in Brief

Public Health Research and Surveillance Priorities from the East Palestine Train Derailment

Proceedings of a Workshop—in Brief

On November 6–7, 2023, the National Academies of Sciences, Engineering, and Medicine hosted a 2-day virtual public workshop[1] on health research and surveillance priorities related to the East Palestine, Ohio, train derailment and hazardous material release that occurred on February 3, 2023.[2] The workshop was intended to explore potential human health impacts and lessons learned from the incident, focusing on research questions specific to affected communities in East Palestine and surrounding areas of Ohio and Pennsylvania. Kristen Malecki, a professor and the division director of Environmental and Occupational Health Sciences at the University of Illinois Chicago, opened the workshop emphasizing the development of a research agenda responsive to community questions and concerns across hazards, exposures, risks, and health impacts to inform strategies for protecting residents now and in the future.

Richard Woychik, the director of the National Institute of Environmental Health Sciences (NIEHS) and the National Toxicology Program, urged participants to actively discuss strategies such as characterizing exposures, determining appropriate health surveillance, examining acute and long-term health effects, and applying insights from prior transportation disasters to aid East Palestine. Discussions centered on perspectives on the impact of the incident, hazardous material exposures and risks, risk characterization and communication, and challenges in and strategies for addressing and monitoring long-term community health impacts. Dr. Woychik also urged for the development of very specific actions for all involved parties to take and address the challenges faced by the East Palestine community.

IMPACT OF THE EAST PALESTINE TRAIN DERAILMENT

This section covers the physical, emotional, and social impacts described by community members and local responders and providers after the derailment. It highlights the acute health symptoms, mental trauma, loss of trust, financial hardships, gaps in disaster preparedness, mental health care access, and uncertainties concerning long-term health risks reported in the community.

Community Member Perspectives

Panelists representing community perspectives described the physical, emotional, and social tolls that

[1] The workshop agenda and presentations are available at https://www.nationalacademies.org/event/40970_11-2023_public-health-research-and-surveillance-priorities-from-the-east-palestine-ohio-train-derailment-a-workshop (accessed December 12, 2023).
[2] Addition background about the incident is available at https://www.epa.gov/east-palestine-oh-train-derailment/background (accessed November 13, 2023).

the derailment and response took on East Palestine residents in both the short and long term. Numerous acute symptoms such as rashes, headaches, and nausea were reported, which [redacted], a resident of Columbiana County, and Jess Conard, the Appalachia director of Beyond Plastics, associated with chemical exposures. [redacted] also a resident of Columbiana County, expressed concerns about potential long-term effects such as cancers, hormone disruption, and respiratory impacts as well as anxiety over health problems manifesting years later with limited testing and monitoring available. [redacted] expressed that the evacuation process was chaotic and poorly communicated, which led to prolonged displacement and financial strain for some families that are still unable to return home months later. [redacted] described additional mental health effects including trauma, a loss of trust, and feelings of abandonment by failing systems meant to protect them. Similarly, Conard also explained that anger and sadness emerged over divisions within the community and cited the bullying experienced by vocal residents. She also noted exhaustion and burnout from having to fight for answers and resources. However, perspectives differed on how widespread health issues are in the community. For example, Bill Sutherin, the director of the United Methodist Committee on Relief, stated that among people he spoke with, either downtown or in church settings, most have not reported problems related to the incident though he acknowledged that some community members have experienced anxiety related to the event.

In terms of information needs, [redacted] expressed frustration with the lack of transparency and access to data from officials. With no single clear source of information, many did their own extensive research to understand risks, reaching out to varied experts, agencies, and affected communities from prior disasters, according to Conard, [redacted]. However, this often yielded contradictory information and no definitive answers, [redacted] said. [redacted] and Conard further stated that distrust was highest toward Norfolk Southern, the Environmental Protection Agency (EPA), and local leaders accused of downplaying risks. Adding to [redacted]s and [redacted]s sentiments about information availability and quality, Sutherin said that the released monitoring data could have been better, with "more down-to-earth explanation as the months passed about the data instead of such a high technical point of view." Conrad and [redacted]alled for centralized resources, continued monitoring, and accountability for those deemed responsible.

Responder and Provider Perspectives

Panelists representing responders and providers involved with the incident shared their perspectives on patient impacts, training and education, ongoing research, and concerns about potential long-term health effects. Mental health professionals Kristen Barefield, a family therapist at Metta Wellness, and Marcy Patton, the executive director of the Columbiana County Mental Health and Recovery Services Board, reported that the derailment took a major emotional and psychological toll on many East Palestine residents, both immediately and in the long term. Barefield observed increased anxiety, depression, and posttraumatic stress disorder (PTSD) symptoms in existing clients as well as in new clients coming for help after the event at her private practice office. Patton explained that the evacuation was extremely traumatic, with ongoing stress for those still displaced months later. Both noted gaps in mental health services and available research on the long-term psychological health impacts of similar environmental disasters.

According to Gretchen Nickell, the chief medical officer at the East Liverpool City Hospital and the medical director for the Columbiana County Health District, many patients reported acute physical symptoms such as rashes; irritation of the eyes, ears, nose, and throat; respiratory symptoms; and nausea, which improved when leaving the contaminated area, even temporarily. However, she said, gaps in research on the specific chemical exposures from the derailment make it impossible to definitively link symptoms to the event. Nickell said that long-term health screenings are available at the new clinic in East Palestine, but uncertainty remains concerning access to additional specialty care if health effects emerge over the long term.

Providers also acknowledged gaps in disaster preparedness and training. George Garrow, the chief

executive officer of Primary Health Network, and Barefield, said that clinicians lacked training on responding to environmental disasters and exposures. Garrow said that environmental exposures and toxicology are not well covered in standard medical education. Barefield and Patton also noted limits on the sorts of research on mental health impacts that was needed to properly inform the response. Garrow emphasized the need to continue learning to better monitor patient health in the long term in order to address the uncertainty that Nickell described.

While providers came together collaboratively to support the community in the immediate aftermath, Patton and Nickell shared concerns about the dearth of the sorts of training, research, and resources needed to adequately monitor potential long-term health effects. Continued education, surveillance, specialty care access, and mental health support will be crucial in caring for affected residents in the months and years ahead, Nickell said. The desire for long-term tracking of potential health effects was also emphasized by all panelists.

HAZARDS, EXPOSURES, AND RISKS

This section summarizes individual presentations and discussions that cover findings from environmental and health assessments conducted after the derailment by government agencies and academic researchers. Speakers highlighted air, water, and soil sampling results as well as reported acute health symptoms and discusses remaining uncertainties about long-term impacts.

Environmental Monitoring and Exposure Science

In presentations, speakers highlighted extensive environmental sampling conducted in East Palestine across air, water, and soil, while also acknowledging that key data gaps remain regarding long-term monitoring, health impacts, risk communication, and chemical mixture exposures that require further research and analysis.

Mark Durno, the response coordinator for EPA's Region V, reported that extensive air monitoring and sampling was conducted after the East Palestine train derailment using stationary monitors, mobile labs, and volatile organic compound (VOC) analysis methods, with more than 115 million measurements collected. However, he acknowledged limitations in the ability of indoor screening techniques to detect certain chemicals such as butyl acrylate at low levels. Specifically, he said that a study found that the detectors could not reliably detect butyl acrylate below certain low concentration thresholds that are relevant for evaluating community health impacts. Adding to this, Albert Presto, a research professor in mechanical engineering at Carnegie Mellon University, discussed his team's use of using advanced mobile sampling and proton transfer reaction–mass spectrometry (PTR-MS) instrumentation to map concentration gradients and identify potential exposure hotspots. But Presto cautioned that this provided only short-term data; continuous monitoring was required to identify long-term concentration trends. Both Durno and Presto cited gaps in rapidly communicating complex datasets to the public in readily understandable formats and contexts. Advanced technologies such as PTR-MS allow rapid, specific chemical measurements but require significant dedicated resources, Presto explained. Durno noted that EPA trace atmospheric gas analyzer units are often unavailable for emergencies and advocated integrating emerging technologies such as PTR-MS with conventional monitoring to take advantage of the strengths of both approaches.

Transitioning the discussion to indoor air monitoring, Durno detailed EPA's vapor intrusion assessment process using the contaminant source pathway. He reported that hydrogen chloride and vinyl chloride sampling was done in around 100 East Palestine homes, with no detections. However, Presto cautioned that commercial canister tests often provide limited context on the origins of detected compounds. For example, photoionization detectors indicate general VOC levels but cannot pinpoint specific sources. Expanding on Durno's and Presto's remarks, Andrew Whelton, a professor of civil engineering and environmental and ecological engineering at Purdue University, said that in addition to regulatory sampling, his research team conducted field investigations to assess contamination distributions across sites, including homes, businesses, soil, and consumer products. He reported finding heavy, heterogeneous contamination

slugging through area creeks weeks after the derailment, which differed from some official water sampling results. He also said that 2-butoxyethanol was not screened for initially, and other VOCs were still present at concerning levels in buildings months after the derailment, indicating potential vapor intrusion risks from contaminated creek water flowing beside and underneath buildings that require further examination.

For future incidents, Presto and Durno suggested rapid deployment of advanced instrumentation and measuring as many compounds as possible at high time resolution. Durno emphasized collecting early samples to identify key contaminants and advised carrying out proper planning and quality assurance for defensible, meaningful data. Durno and Presto both encouraged quick multi-faceted air sampling and monitoring using conventional and emerging technologies, and they said there had been gaps in the effort to rapid communicating complex datasets to the public in readily understandable formats and contexts. Durno further highlighted the value of partnering EPA data with university and community efforts. Concluding the discussion, Whelton urged data transparency and collaboration so that affected residents can benefit from monitoring efforts.

Human Health Impacts

Panelists from government agencies, medical centers, and academic institutions presented findings from health surveys and exposure assessments conducted in the aftermath of the East Palestine train derailment, providing insights into acute symptoms while discussing uncertainties concerning potential long-term impacts.

Motria Caudill, the regional director of the Region V Office with the Agency for Toxic Substances and Disease Registry (ATSDR), said that ATSDR conducted community and first responder health surveys in March 2023, within weeks of the February derailment incident. According to Caudill, the community survey found symptoms like nose, throat, and eye irritation were most commonly reported, along with headaches and mental health effects. Caudill added that these acute symptoms were consistent with known irritant exposures and were expected to resolve after the incident. The first responder survey showed high rates of similar acute symptoms, she said, and found that as many as 70–90 percent of responders in commonly reported jobs were not wearing protective masks or respirators during initial incident response.

Adding to this, Nicholas Newman, the director of the Environmental Health and Lead Clinic at Cincinnati Children's Hospital, said that poison control centers (PCCs) received more than 200 exposure-related calls regarding East Palestine, mostly about respiratory, neurological, and gastrointestinal symptoms. He advised regular check-ups to monitor potential long-term effects, eliminate ongoing exposures, and manage current symptoms. Realizing the need for more information, Newman assisted in developing chemical fact sheets for PCC staff. While they found them useful, he said, staff members saw a need for expanded clinical guidance with updated research on management decisions, diagnosis, and treatment recommendations for physicians dealing with potential exposures, particularly for children and pregnant women.

Erin Haynes, the chair of the Department of Epidemiology and Environmental Health at the University of Kentucky, presented preliminary data from a community health tracking survey that showed high rates of respiratory, neurological, dermal, and gastrointestinal symptoms as well as indicators of stress and PTSD attributed to the derailment. Haynes discussed efforts to assess chemical exposures through blood, urine, and wristband samples. She emphasized working closely with community members for meaningful participatory research.

Similarly, Lauryn Spearing, an assistant professor in civil, materials, and environmental engineering at the University of Illinois Chicago, shared findings from a community survey examining impacts and experiences after the East Palestine train derailment. Key findings included the evacuation or relocation of many residents, odors noticed in homes, and increased bottled water use due to drinking water concerns. Despite environmental sampling efforts, she said, most community respondents that received results found the results unclear or

untrustworthy. Residents felt that recovery resources and decision-making processes lacked transparency and equity. Many also reported not receiving clear guidance or information on long-term health consequences. Spearing highlighted the needs for improved communication, building trust in agencies, transparency, equitable resource allocation, and long-term monitoring to protect community health.

Regarding the acute health effects such as irritant symptoms and mental health impacts that were reported in community and first responder surveys, Caudill said that, based on current knowledge, these acute effects are expected to resolve over time. However, Caudill, Haynes, and Newman acknowledged substantial uncertainty regarding potential long-term health impacts that may emerge months or years later, requiring continued monitoring and research. To respond to community members' interest in measuring biomarkers of exposure, Haynes highlighted her efforts to collect biological samples for analysis and engage members of the community in the development of data and report-back materials. Caudill said that ATSDR did not do any environmental sampling or biological sampling for exposure measures because there were no known reliable tests for the chemicals of concern. Given the uncertainties about future impacts, several panel members emphasized the need for continued health monitoring and research of exposed populations. Recommendations from Newman and Caudill to improve future response included enhancing coordination across health agencies and establishing standardized communication procedures in advance of disasters. Caudill further commented that ATSDR is working to streamline communications and engage PCCs earlier in a disaster response. Newman and Caudill also cited the need for concise clinical guidance documents and rapid distribution mechanisms to inform health care providers about chemicals and other exposures of concern related to the disaster.

Finally, Haynes and Newman emphasized that collaborating closely with community members and organizations can help build trust and help develop effective communication strategies and messages including when communicating complex technical results bearing on risks and recommendations for communities. Spearing also emphasized the importance of improving risk communication to both community members and providers in disaster response.

RISK CHARACTERIZATION AND COMMUNICATION

Panelists next discussed challenges in disaster risk characterization and risk communication, with various panel members highlighting needs for accessible toxicity data and meaningful community engagement from diverse perspectives. Keeve Nachman, an associate professor at the Johns Hopkins Bloomberg School of Public Health, explained the risk assessment paradigm that uses diverse evidence to translate exposures into characterized health risks.[3,4] These risks in turn guide risk management decisions and communication strategies to answer community questions about safety, Nachman said.

Building on this concept, Weihsueh Chiu, a professor of veterinary physiology and pharmacology at the School of Veterinary Medicine and Biomedical Sciences at Texas A&M University, spoke about translating East Palestine air monitoring measurements into exposure and risk estimates. He outlined the difficulties of clearly communicating the complex continuum of risk to the public when data contain gaps and uncertainties. Chiu also pointed out that transitioning from quantitative hazard quotients to plain language descriptions of safety involves dealing with some uncertainty, which will need to be communicated as well.

Furthering this discussion, Sue Fenton, the director of the Center for Human Health and the Environment at North Carolina State University, reviewed a scoping report[5] from NIEHS summarizing the known hazards of East Palestine contaminants. She emphasized using

[3] National Research Council. 1989. *Improving Risk Communication*. Washington, DC: The National Academies Press. https://doi.org/10.17226/1189 (accessed December 12, 2023).
[4] National Research Council. 2009. *Science and Decisions: Advancing Risk Assessment*. Washington, DC: The National Academies Press. https://doi.org/10.17226/12209 (accessed December 12, 2023).
[5] For more information the NIEHS report, see https://www.niehs.nih.gov/research/atniehs/assets/docs/east_palestine_report_508.pdf and https://www.epa.gov/chemical-research/comptox-chemicals-dashboard (accessed November 22, 2023).

curated authoritative toxicity data sources to ensure reliability. Fenton also noted that mixtures of chemicals pose challenges, as potential interactions are often unknown.

Antony Williams, a scientist at EPA's Center of Computational Toxicology and Exposure, described advanced cheminformatics tools that make possible the rapid gathering of chemical hazard and safety data to inform emergency response and risk assessment. He said that existing publicly accessible applications like the CompTox Chemical Dashboard[6] and the Cheminformatics Modules, including the Hazard Profile Module,[7] allow for efficient mining of disparate data to characterize risks and potentially help to guide actions.

Wesley Vins, the health commissioner for Columbiana County, shared his firsthand experience communicating during the East Palestine disaster response. He highlighted difficulties managing information flow among government agencies at different levels, media partners, and concerned community members. Vins stressed the importance of coordinated messaging, given public expectations for transparency. Nachman echoed this, emphasizing the importance of transparently conveying uncertainties and involving stakeholders throughout the process.

The panelists addressed several important questions related to the East Palestine train derailment and its potential health impacts. Fenton and Chiu explained that dioxins are a complex mixture, making risk assessment challenging. There are limited authoritative sources that quantify risks from specific dioxins, Fenton said, and while there are clearly associated health outcomes, more research is needed to determine relative potency factors. Nachman acknowledged that as scientific understanding of chemicals' propensity to elicit adverse health effects evolves, toxicological reference values should be lowered to reflect new sensitive endpoints when supported by evidence. He went on to highlight the importance of considering more than just the most sensitive endpoints associated with chemical exposures, especially in the case of chemical mixtures. He noted that the combined toxicity of multiple chemicals may elicit additional effects beyond the most sensitive ones associated with the individual chemical constituents of the mixture. Fenton said that NIEHS's scoping review of potentially hazardous contaminants considered how recent each review was, giving more weight to newer science.

Nachman introduced the critical issue of assessing health risks from cumulative exposures, particularly regarding how to evaluate the combined effects of chemical mixtures in disasters. He said that properly characterizing threats is challenging, given the significant data gaps. Adding context, Chiu and Nachman said that a typical approach today relies on component-based approaches (e.g., calculating the hazard index) that are summed quantitatively, although some whole mixtures, such as diesel particulates, are assessed jointly. Chu suggested that additional research is needed on in vitro methods that can better evaluate interactions and synergy. Nachman noted that assessments commonly assume additivity between chemicals—a limitation, given the uncertainties concerning the effects of the nature of chemical interactions when synergy and antagonism may also be possible. He emphasized the importance of considering exposure scope when managing mixture risks rather than focusing solely on quantifying uncertain interactions. Williams highlighted emerging computational mixture assessment methods, although chemical interaction data remain limited.

Some of the panelists agreed that substantial data gaps severely restrict precision in cumulative risk quantification. Nachman highlighted how assessments predominantly add up independent chemical risks, neglecting potential interactions among mixture components. Nachman and Williams mentioned the value of analyzing toxicity pathways across mixtures and predictive approaches to model interactions. But some of the discussants also called for more real-world mixture research to comprehensively evaluate disaster releases. For example, Chiu indicated that animal models could be used to test mixtures and that there is interest in using in vitro methods to examine synergy or antagonism of

[6] For more on the CompTox Chemicals Dashboard, see https://www.epa.gov/chemical-research/comptox-chemicals-dashboard (accessed November 13, 2023).
[7] See https://www.epa.gov/comptox-tools/cheminformatics (accessed December 14, 2023).

compounds in a more rapid manner. He added that there is future potential to take samples from a particular incident and rapidly test for a whole mixture screening of potential toxicity but acknowledged that the technology is not yet ready for field application. Regarding potential biomonitoring[8] in exposed populations, Fenton and Chiu said that per- and polyfluoroalkyl substance (PFAS) markers from firefighting foam would be unique long-term indicators of exposure not otherwise present. While many chemicals dissipate, they agreed that PFASs and dioxins persist in the body to serve as biomarkers.

OPPORTUNITIES TO ASSESS AND ADDRESS LONGER-TERM COMMUNITY HEALTH IMPACTS

Speaker discussions throughout the workshop highlighted insights from previous disasters and health crises, focusing on the integration of research with practical action, vigilant monitoring for effects, the implementation of community-centered strategies, and the consideration of long-term health consequences to aid in the recovery of East Palestine.[9]

Research and Action Integration

Speakers discussed long-term health studies and community partnerships established after past disasters that have advanced scientific knowledge while providing the affected populations with essential health monitoring and resources. Melanie Pearson, an associate professor of environmental health at the Emory University Rollins School of Public Health, spoke about the Michigan Long-Term Polybrominated Biphenyl (PBB) Study and Registry[10] as an example of how to monitor and address health concerns by partnering with the exposed community after contamination disasters. The PBB registry, which was established in the 1970s after widespread agricultural contamination in Michigan, has tracked health outcomes in exposed populations for more than 50 years. Pearson said that the long-term research has uncovered elevated risks of cancers and other diseases tied to PBB exposure as well as multi-generational health impacts. Importantly, she emphasized that collaborating with affected communities to understand concerns and integrate them into the science has been key to producing relevant findings, building trust in the research, and catalyzing public health action.

Building on this, Michele Marcus, a professor of epidemiology, environmental health, and pediatrics at the Emory University Rollins School of Public Health, said that conducting studies after disasters like the Michigan Long-Term PBB Study help communities heal by determining how to prevent and mitigate health impacts. Nachman agreed, explaining that research partnerships have advanced science and public health around specific disasters such as the Michigan PBB contamination. Linda Birnbaum, an adjunct professor in the Department of Environment Sciences and Engineering at the University of North Carolina's Gillings School of Global Public Health, emphasized that disaster research should aim to improve the science base for protecting both physical and mental health during disasters and in their aftermath. She said that research is needed to better understand health impacts in the short and long term, to establish the safety of treatments, to characterize exposure risks, to assess the efficacy of decontamination efforts, and to identify vulnerable groups. Birnbaum added that studies should engage partners across academia, agencies, businesses, and communities while integrating with emergency response teams. She highlighted the Disaster Research Response (DR2)[11] Program's repository of data-collection tools and pre-approved research protocols that can equip scientists to gather data more quickly when disasters occur.

Environmental and Health Monitoring

Several presenters emphasized that analytical methods to identify chemicals and quantify exposures used in combination with long-term biomonitoring can help reconstruct past exposures and their health impacts when real-time data are limited. Judy Westrick, the

[8] Biomonitoring refers to the assessment of human exposures to chemicals by measuring these substances or their metabolites in biological specimens such as blood or urine.

[9] This section is the rapporteurs' summary of points made by the individual speakers identified, and the statements have not been endorsed or verified by the National Academies of Sciences, Engineering, and Medicine. They are not intended to reflect a consensus among workshop participants.

[10] For more information on the Michigan Long-Term PBB Study and Registry, see https://sph.emory.edu/pbbregistry/index.html (accessed November 13, 2023).

[11] For more information on the DR2 see https://www.niehs.nih.gov/research/programs/disaster/index.cfm (accessed November 22, 2023).

director of the Lumigen Instrument Center at Wayne State University, explained various analytical methods to identify chemicals over time after spills and track contamination. She said that targeted analysis can quantify known hazardous substances based on available methods. However, she added, untargeted screening can be valuable for discovering unknown contamination. For example, her team used untargeted gas chromatography–mass spectrometry to identify concerning compounds such as 2-ethylhexanol and hexanal. Westrick recommended integrated targeted and untargeted monitoring of environmental and biological samples to fully characterize exposures and metabolites. She said that new techniques like metabolomics and exposomics research can help link exposures to health risks and resilience. Marcus said that after the East Palestine derailment, independent chemical measurements provided key information when government assurances failed to satisfy community concerns. Chiu noted that analyzing the health risks of chemical mixtures like dioxins remains challenging due to the large number of potential compounds and limited authoritative sources quantifying their relative potencies. In ideal circumstances, biomarkers should be collected as the exposure event is happening, but most often samples are collected after an event has occurred according to Manish Arora, a professor and the vice chair of environmental medicine and public health at the Icahn School of Medicine, Mount Sinai. Because the half-life for many chemicals containing blood and urine is too short to capture a record of past exposures, Arora said that biomarkers in teeth, hair, and blood can reconstruct past exposures even when traditional measures return to baseline levels. He explained that biomarkers in shed baby teeth provide a precise record of fetal and early childhood exposures that can be mapped over time by sampling microscopic layers reflecting weekly exposures. Though more limited in timescale, hair biomarkers also enable mapping of prior exposures following disasters. Arora advocated combining emerging biomonitoring tools with traditional measures in exposed populations to fully characterize exposure scopes and histories.

In a related vein, Phillip Landrigan, the director of Global Public Health and the Common Good at Boston College and formerly the director of preventative medicine at the Icahn School of Medicine, Mount Sinai, described the importance of creating exposure registries of responders and community members, such as the World Trade Center Registry[12] and the Flint Registry,[13] to create a foundation for relating exposures to health outcomes. For example, the World Trade Center Registry enabled documentation of exposure–response relationships between cumulative dust inhalation and severity of both pulmonary dysfunction and mental health problems in first responders. Mona Hanna-Attisha, the associate dean for public health at Michigan State University, added that establishing the Flint Registry following the Flint, Michigan, water crisis allowed exposure assessment and longitudinal tracking of health indicators and referrals to health services.

Community-Centric Approaches

Panelists shared lessons from past disasters that could shape community-engaged approaches to validate resident experiences, build trust, and increase research accessibility following the East Palestine incident. Jennifer Horney, a founding director of and professor in the epidemiology program at the University of Delaware, emphasized that disaster severity is in part a function of community structures and resources. Engaging affected populations in research often improves health outcomes while building community capacity, she said. Echoing this, Erika Kinkead, a certified school nurse, the New Brighton Area school district president, and a member of the Beaver County School Nurse Association, said that trust building requires validating resident experiences and concerns. Joan Casey, an assistant professor of environmental and occupational health sciences at the University of Washington, advocated for forming community partnerships to inform study design, data collection, analysis, and communication of findings in accessible ways as a way of increasing inclusion. However, she noted, academic timelines often lag behind community needs.

[12] For more information on the World Trade Center Registry, see https://www.nyc.gov/site/911health/about/wtc-health-registry.page (accessed November 22, 2023).
[13] For more information on the Flint Registry, see https://flintregistry.org (accessed November 13, 2023).

Concerning roles for community representatives, Hanna-Attisha said that the Flint Registry staff were hired from affected communities to ensure responsive, trauma-informed research practices that mitigated harms. Marcus said that community members catalyzed action after the PBB contamination by demanding research and cleanups when institutions failed to protect public health. Supporting state and local health departments is a priority, but many are under-resourced, making it difficult to fully engage communities in crises, said Hanna-Attisha, Landrigan, and Patrick Breysse, a professor emeritus at the Johns Hopkins Bloomberg School of Public Health. Breysse also emphasized early community partnerships and trust as well as the prioritization of diverse local needs, transparent communication, timely data release, and interagency coordination. Because health departments have the primary responsibility for addressing these problems but are chronically underfunded, Breysse, Landrigan, and Burke further advocated for securing more resources to bolster state and local health department capacity to aid communities dealing with environmental incidents.

Long-Term Health Impacts and Interventions

Panelists described studying disease progression, mental health impacts, and multigenerational effects and improving provider education as being critical to addressing long-term physical and psychological consequences in affected communities. Juliane Beier, an assistant professor of medicine at the University of Pittsburgh, shared information about her studies of metabolic dysfunction associated steatotic liver disease (formerly known as nonalcoholic fatty liver disease) and how environmental exposures may interact with underlying risk factors to drive disease progression. She explained that examining mechanisms underlying progression stages and risk modifiers helps determine how chemical co-exposures combine with preexisting conditions and other stressors to negatively affect health over time. Her work focuses specifically on the impacts of exposures such as vinyl chloride, including the effects of exposure on inflammation, fibrosis, and cancer risk, when combined with such factors as obesity-associated metabolic dysfunction.

Hanna-Attisha emphasized that addressing trauma through mental health care is as vital as assessing toxic exposures, given population-level loss of trust. Marcus said that the possible presence of long-term effects make multigenerational tracking critical, because epigenetic changes and similar issues will emerge gradually. She called for improving physician education on addressing environmental exposures as a way to enhance patient care and community support. Landrigan suggested using both exposure rosters and clinical databases to relate responder exposures to long-term respiratory and other health effects that appear years later.

CONCLUDING DISCUSSIONS

In her closing remarks, Malecki described ongoing challenges in East Palestine that have been reported by community members, including persistent health issues, uncertainty regarding future health risks, trauma from the events that unfolded, and ongoing displacement coupled by longer-term feelings of hopelessness for those with unanswered questions and continued health concerns. She emphasized the need for research to monitor the longer-term health impacts and how this event and those that were discussed can support more robust research to advance disaster preparedness particularly for VOCs with short half-lives and unknown health risks. The community remains divided regarding the adverse impacts and ongoing issues adding to the psychosocial toll and pervasive mental health concerns. However, she noted that residents primarily desire that action be taken, rather than simply having additional recommendations shared with them.

The nature of the train derailment and proximity of East Palestine as a border city required a multi-state response. This led to a more complicated response effort requiring coordination across multiple jurisdictions and response agency authorities, Malecki said. The response required coordination of the Ohio and Pennsylvania Departments of Public Health who sought information from regional ATSDR and EPA locations. Ohio is part of Region V and Pennsylvania is part of Region III for both agencies. Early health data presented during the workshop showed adverse impacts across age groups

and that many clinical responders, including primary care and emergency department physicians, lacked the necessary environmental health training to address community concerns regarding exposures and related health impacts. While ATSDR and other agencies did provide information and fact sheets regarding exposures and risks from the derailment, poison control center responders indicated practitioners on the ground wanted more digestible clinical guidance based on community testimonies. Agencies did respond, but this information could have been available with increased research into the health impacts of acute exposures and understanding of the complex mixtures emanating from the train derailment and subsequent burning. Malecki emphasized resolving uncertainties, expanding data collection to advance research, listening to community concerns, and acting quickly to address these concerns and establish research to monitor long-term health impacts.

Additionally, several presenters and discussants underscored that continued collaborative efforts centered on integrating East Palestine community priorities will be essential to implementing meaningful solutions and rebuilding trust. Multiple moderators highlighted the urgency of coordinating research initiatives in order to maximize the efficient use of resources while maintaining strong communication channels with participating residents. Haynes prioritized environmental exposure assessment, biomarker development and collection, the need for long-term follow-up, and effective communication messages and strategies, and stressed the need for community coordination, ownership, and engagement throughout all of these activities to ensure that the data collection and report-back is meaningful to the community. Connecting to those priorities, Harold "Fritz" Nelson, the pastor of the First United Presbyterian Church of East Palestine, emphasized that science should be conducted carefully to validate community experiences and provide data to empower local advocacy around urgent needs. He also called for multidisciplinary and multi-institutional efforts that will enable coordination and trust-building across involved stakeholders, from government agencies to academic researchers to community groups. In line with strengthening collaboration, Whelton expressed hope that this event will spark actionable change centered on helping East Palestine while also addressing related problems on a national level. However, communication gaps remain an issue, according to Nachman, who spotlighted the information chaos and uncertainty concerning health impacts. He recommended updating evidence-based risk communication strategies to account for modern barriers related to information overload and social/political polarization. Nachman also suggested improving training on mixtures risk assessment specifically for public health professionals on the frontlines. Echoing concerns about the public health infrastructure, Roberta Lavin, a professor in and the deputy director of the Center for Health Equity and Preparedness at the University of New Mexico College of Nursing, acknowledged gaps in chemical exposure education for many health care providers. She called for addressing persistent divides separating experts and community members affected by environmental disasters.

Furthering the discussion, Marcus stressed the value of helping East Palestine residents regain control of their health, while noting the importance of identifying and eliminating any continuing exposures from the train derailment aftermath. Marcus also advocated for research that supports health care providers in protecting community health and preventing potential long-term consequences. Adding further context, Maureen Lichtveld, the dean of the University of Pittsburgh School of Public Health, advocated for a clear roadmap linking research to action, with the existing gaps made explicit. She noted the difference between funding streams for scientific studies versus funding for health services and called for transparency around this issue when communicating with the community. Lichtveld emphasized the need for additional provider training and for making a commitment to establish a disease/exposure registry. Finally, Thomas Burke, a professor emeritus at the Johns Hopkins Bloomberg School of Public Health, expressed concern about the lack of a playbook with established guidelines for disaster responses. He advocated a greater focus on clinical preparedness and medical infrastructure to adequately meet community needs in the wake of environmental crises. Burke pointed

to some progress made in Flint following the water contamination scandal as a model to apply to the East Palestine recovery efforts.

In closing the workshop, Aubrey Miller, the deputy director of scientific coordination at NIEHS, underscored the need for comprehensive health-informed disaster research and surveillance. He noted systemic challenges in connecting science, public health practice, and community needs in the wake of catastrophes like the East Palestine train derailment. While pockets of progress exist, he said, citing efforts following the *Deepwater Horizon* BP Gulf of Mexico Oil Spill,[14] the prevailing narrative emerging from East Palestine and an increasingly frequent and severe pattern of incidents signals the urgency for change. Miller emphasized that the consequences of disasters like East Palestine persist long after the initial incident. While cleanup efforts may be swiftly completed, Miller concluded that trauma continues to linger within affected communities. He stressed that the full impacts extend beyond physical environmental damage, encompassing chronic mental and emotional burdens as well. What heals and sustains devastated populations over the long term, Miller emphasized, involves translating data into effective preparedness, responsive systems, and future looking recovery efforts that people can trust. He described vital synergies where research, clinical experience, and public health surveillance come together, not as isolated domains. He stressed the importance of considering mental health needs along with continuing environmental exposures and health risks disproportionately affecting vulnerable groups. Overall, Miller conveyed hope that by working together across sectors, initiatives could effectively inform practice and interventions over the long term in order to help the community heal.

Potential strategies for addressing and monitoring community health impacts offered by individual speakers can be found in the Box.

[14] For more information on the Gulf Oil Spill, see https://www.epa.gov/enforcement/deepwater-horizon-bp-gulf-mexico-oil-spill (accessed November 23, 2023).

BOX

Potential Strategies for Addressing and Monitoring Community Health Impacts Based on Statements from Individual Speakers[a]

Potential Near-Term Strategies

- Maintaining community partnerships, communication, and trust-building while transitioning from response to long-term research and surveillance (Casey, Horney).
- Establishing registries to track exposed individuals long term and relate health outcomes to the disaster (Hanna-Attisha, Landrigan, Pearson).
- Developing continuing education and training to equip health care providers to monitor and address environmental health issues (Garrow, Marcus, Newton).
- Employing trauma-informed mental and behavioral health interventions alongside assessing toxic exposures (Hanna-Attisha).
- Using diverse biomarkers (e.g., blood, urine, teeth, or hair) to reconstruct past exposures and understand persistent body burden (Arora, Fenton, Westrick).
- Continuously monitoring the environment along exposure pathways like vapor intrusion as contamination spreads over time (Westrick, Whelton).
- Sharing findings transparently and accessibly with affected communities throughout the process (Kinkead, Pearson).

continued

BOX CONTINUED

Potential Longer-Term Strategies

- Resolving uncertainties around health impacts through continued research and data expansion (Malecki).
- Mitigating potential damage due to exposures and developing multigenerational tracking given the possibility of latent effects emerging in those exposed during vulnerable periods of development (in utero or in childhood) (Marcus, Pearson).
- Appling advanced techniques like metabolomics, proteomics, and epigenetics to identify molecular signals predating the development of disease (Beier, Pearson).
- Evaluating interactions between chemical exposures and other stressors to determine how mixtures impact health (Beier, Chiu, Nachman).
- Bridging disconnects impeding public health, academic studies, and community priorities around disasters (Miller).

[a]This list is the rapporteurs' summary of points made by the individual speakers identified and the statements have not been endorsed or verified by the National Academies of Sciences, Engineering, and Medicine. They are not intended to reflect a consensus among workshop participants.

DISCLAIMER This Proceedings of a Workshop—in Brief was prepared by **Justin Snair, Matthew Masiello,** and **Scott Wollek** as a factual summary of what occurred at the workshop. The statements made are those of the rapporteurs or individual workshop participants and do not necessarily represent the views of all workshop participants; the planning committee; or the National Academies of Sciences, Engineering, and Medicine. Artificial intelligence (AI) tools including Otter.ai, Petal AI, and Claude 2 were used in the initial drafting of this Proceedings of a Workshop—in Brief. All materials generated by AI tools were based on the public workshop and were fact-checked to ensure accuracy of the presented information.

* The National Academies of Sciences, Engineering, and Medicine's planning committees are solely responsible for organizing the workshop, identifying topics, and choosing speakers. The responsibility for the published Proceedings of a Workshop—in Brief rests with the institution. The planning committee comprises **Kristen Malecki** (*Chair*), University of Chicago; **Thomas Burke,** Johns Hopkins Bloomberg School of Public Health; **Carol Cunningham,** Ohio Department of Public Safety; **Kristen Dickerson,** Ohio Department of Health; **Erin Haynes,** University of Kentucky; **Darryl Hood,** The Ohio State University; **Alex Kemper,** Nationwide Children's Hospital; **Erika Kinkead,** New Brighton Area School District; **Roberta Lavin,** University of New Mexico; **Maureen Lichtveld,** University of Pittsburgh School of Public Health; **Michele Marcus,** Emory University; **Julie Miller,** Pennsylvania Department of Public Health; **Keeve Nachman,** Johns Hopkins Bloomberg School of Public Health; **Harold "Fritz" Nelson,** First United Presbyterian Church of East Palestine; **Ivan Rusyn,** Texas A&M University; and **Andrew Whelton,** Purdue University.

REVIEWERS To ensure that it meets institutional standards for quality and objectivity, this Proceedings of a Workshop—in Brief was reviewed by **Patrick Breysse,** Johns Hopkins University, and **Erika Kinkead,** New Brighton Areas School District. **Leslie Sim,** National Academies of Sciences, Engineering, and Medicine, served as the review coordinator.

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STAFF **Scott Wollek, Lisa Brown, Matthew Masiello, Shalini Singaravelu, Michael Berrios, Rayane Silva-Curran,** and **Elizabeth Boyle**.

For additional information regarding the workshop, visit https://www.nationalacademies.org/our-work/public-health-research-and-surveillance-priorities-from-the-east-palestine-ohio-train-derailment-a-workshop.

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Health and Medicine Division

EXHIBIT 27

Independent Toxicology Expert: "I Predict East Palestine OH Train Derailment Chemical Release Deaths May Become Worse Than 9/11"

George R. Thompson, Ph.D.[1]

My independent expert analyses of the chemicals in the railcars, and their subsequent fire, following the train derailment in East Palestine Ohio identified over 100 highly toxic chemicals that have the potential to result in long-term medical injuries and environmental contamination.[2] Because of the downwind atmospheric dispersion of the smoke-plume hazardous products, the potential for farmland contamination and surface water pollution, the long-term human health effects from this accident may be worse than occurred from 9/11. The fire potentially released 3,000-6,000 tons of highly toxic soot, ash, and hazardous chemicals[3] into a massive smoke and mushroom cloud that slowly dissipated hundreds of miles beyond the derailment area contaminating gardens, farmland, animals, and communities in perhaps 5, or more, different states.[4]

Recent reports have stated that the delayed deaths for firefighters from 9/11 will shortly surpass accumulated deaths over the past 22 years.[5] In addition, the World Trade Center Health Program reported in 2023 that 71,000 individuals have been diagnosed with health conditions related to exposure to the dust, smoke, debris, and trauma of the 9/11 attacks. One 9/11 survivor has since survived cancer four times.[6] I fear that similar delayed deaths from the East Palestine massive chemical "stew" release will accrue in eastern Ohio, Pennsylvania, West Virginia, and perhaps beyond. One of the railcar chemicals was been detected at low levels in the Ohio River bordering West Virginia within about one week.[7] The impact from tons of soot/ash chemical contaminants on farmland across these states remains unknown. However, if some of these highly hazardous and long-lived chemicals enter the food chain, health effects will continue to accrue for years to come and in communities far from East Palestine OH.

Of the 52 railcars identified in the Norfolk Southern manifest, 31 were identified with various affected-by-the-fire descriptors (i.e., burned or impinged). In addition, 27 cars contained 12 different chemicals, 8 cars contained 4 petroleum products, and 13 cars contained food products.[8] Of the original 31 railcars with chemicals, I have verified that 8 cause cancer, allergies, and aquatic toxicity. However, my fire research has determined that the number of additional, highly toxic chemicals, or chemical classes, released by the fire included 115 that cause cancer, 65 that produce brain/central nervous system effects, 45 that cause heart disease, 42 that cause lung toxicity, 22 that cause asthma, and 11 that cause reproductive effects. Fire-generated carcinogenic chemicals, or chemical classes, included dioxins, polycyclic aromatic hydrocarbons (PAHs), aldehydes, soot, persistent free radicals, and the lung-corrosive gas phosgene. Dioxin levels in residential East Palestine soil tested by independent scientists were 4-10 times background levels.[9] Dioxins would have been produced by the incomplete combustion of chemical products contained in at least 10 railcars (≥200,000 lbs. each). The potential human health and environmental hazards from the chemicals produced by the fire far exceeded hazards from the railcar contents themselves. A question remains regarding the geographic area of concern, since the massive mushroom cloud created from the fire, and observed from space, would have impacted an area far greater than the community of East Palestine Ohio. At least one railcar chemical was detected reportedly at levels below those of concern in the West Virginia Ohio River, approximately 165 miles south of East Palestine.[7]

Shortly after the fire began, local citizens experienced health effects that persist today, one year after the initial incident. One woman and her husband, for example, experienced nose, eye, throat, larynx, and lung irritation within hours after the fire started. They have continued to suffer severe coughing and wheezing, and still do not see an end to their injuries. Another East Palestine resident recently removed and folded his outdoor U.S. flag. Within hours, he developed a severe rash from the dust that had been on his flag. Residents must continue to be diligent about NOT vacuuming any dust in or around their homes or vehicles, since the vacuum exhaust will again spread the contaminated dust leading to at least another round of skin, eye, nose, throat and lung irritation, and body absorption.

Within hours after the fire ignition, animals and pets in the greater area of East Palestine died. Five chickens raised 10 miles northwest of East Palestine died within hours. Multiple foxes near East Palestine died, and several others became sick. The Ohio Department of Natural Resources estimated that more than 43,000 animals died as a result of the derailment and fire.[10] Cows in Pennsylvania reportedly developed diarrhea, and a local farmer that raises pigs was unable to sell his pigs at market - they did not want any livestock from the area of potential exposure.[11]

This train derailment and chemical release by the fire is the most complex and hazardous chemical release accident I have seen in my 50 years of experience as a toxicologist. My greatest fear is that cumulative long-term human health effects across a broad cross section of the Atlantic States will progressively result in thousands of deaths from cancer, heart, kidney, and lung diseases over the next 10-20 years that could potentially exceed those from 9/11. My concerns for the residents of East Palestine, and beyond, are in obvious contrast to the conclusions stated by the Environmental Protection Agency Administrator Michael Regan when he told them 10 days after the derailment and fire that 'their municipal water and air was safe."[12]

Massive chemical contamination of towns has previously occurred in Love Canal NY, Times Beach MO, and even Chernobyl Ukraine. These three towns have one thing in common - their inhabitants and businesses were all removed/evacuated due to massive contamination of the towns with highly hazardous chemicals. The specific contaminant in Times Beach was one chemical, dioxin.[13] The independently derived data of dioxin contamination in East Palestine also warrants the relocation of families and businesses.[9]

Although one year has now passed since this disaster occurred in East Palestine OH, the incident must be re-considered an emergency by local, state, and federal agencies. Residents and their animals can only be protected by evacuating East Palestine and the surrounding area, buying the businesses, and re-locating the citizens to safer areas of their choosing.

Notes and References

1. I have performed independent toxicology hazardous chemical analyses for government agencies, corporations, and academic institutions for over 50 years. I have published 21 books on hazardous chemicals, been an expert witness for more than 50 lawsuits, and spent hundreds of hours researching the hazards of chemical contained in railcars on the East Palestine derailed train, as well as the highly hazardous chemicals created by the fire and released into the air, water, and soil. My personal concerns about the hazards of the millions of pounds of highly hazardous chemicals released by the fire in East Palestine OH have brought me out of retirement with the intent to encourage other independent scientists to become involved in accurately assessing the risks resulting from this health and environmental catastrophe.

2. The 52 railcar contents and outcomes identified in the Norfolk Southern manifest posted on the Internet at the time of the derailment identified 52 cars with 23 different chemicals and chemical products. Incomplete combustion produced up to 14 highly hazardous chemicals, or chemical classes, for each of these identified railcar materials.

3. Each railcar carried potentially 200,000 to 225,000 pounds of materials. The N/S manifest indicated that 17 cars "burned" and 15 cars were "impinged" with fire/flames. Contents in 17 cars totaled >3.4 M pounds (= 1700 tons), and in 32 cars totaled >6.4 M pounds (= 3200 tons).

4. Potentially depositing highly hazardous chemicals bound to particulates perhaps in Ohio, Pennsylvania, West Virginia, Virginia, Maryland, Delaware, and maybe even Washington, D.C.

5. See: *mountsinai.org/about/newsroom/2018deaths -from-911*. See also: *www.cnn.com/2023/09/11/us/neyork-firefighters-911-illness-death/index.html*.

6. See: USA Today, 8 Sept 2023 @ *70780975007/*.

7. See: https://www.wowktv.com/news/west-virginia/is-the-ohio-train-derailment-chemical-spill-impacting-west-virginias-water/

8. Numbers compiled from the Norfolk Southern manifest previously available on their website.

9. B.W. Vigon et als., Society of Environmental Toxicology and Chemistry (SETAC), Poster Presentation, 15 Nov 2023. (breveja2180@att.net.net).

10. https://www.axios.com/2023/02/24/ohio-train-derailment-animals-killed-water

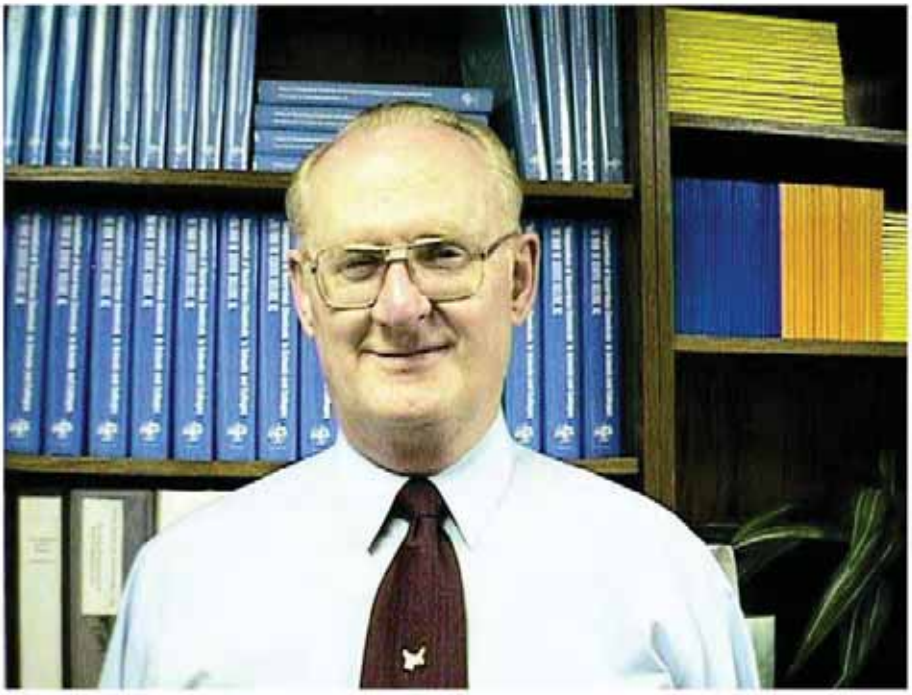
11. East Palestine resident personal communication.

12. https://www.washingtonpost.com/climate-environment/2023/02/16/ohio-train-derailment-response-toxic-contamination/

13. https://www.newsnationnow.com/us-news/midwest/ohio-train-derailment/east-palestine-crisis-mirrors-missouri-times-beach/#:~:text=East%20Palestine%20crisis%20mirrors%20what%20turned%20a%20Missouri%20city%20into%20a%20ghost%20town&text=EAST%20PALESTINE%2C%20Ohio%20(NewsNation),abandonment%20of%20an%20entire%20town.

George R. Thompson, Ph.D.

Curriculum Vitae



Biographical Sketch

Professional History

1969–1983 - Mason Research Institute, Stuart Pharmaceuticals/Atlas Chemicals, Abbott Pharmaceuticals, International Flavors & Fragrances: ✣ Research & Management of Industrial Hazard & Risk Assessments, Including Testing Research that Identified the Acute and Chronic Toxic Effects of Marihuana, Chemical Research, Product Development, Safety Computerization, Medical Compliance, Environmental Assessments in Pharmaceutical, Agrochemical, Flavor/Fragrance Industries.

1983–Present - COMPLIANCE INNOVATIONS, INC., PRESIDENT/CEO (formerly, *The Forum for Scientific Excellence Inc.*): Broad Based Occupational & Environmental Consulting, Compliance Program Development & Implementation, Chemical Audits & Labeling, MSDS/SDS & Hazardous Chemical Database Development, Chemical & Biological Laboratory Evaluations, Crisis Resolution, Policy/Advisor Program, Expert Witness

1991–Present - CHEMICAL COMPLIANCE SYSTEMS, INC, PRESIDENT/CEO
Compiled the Largest Hazardous Chemical Databases in the World, Quantitative GreenSuite® Chemical Hazard & Product, Process, & Waste Stream Risk Assessments, Developed 44 Web-Based Analytical Compliance Software Systems – 18 for Department of Defense Munitions & Weapons Analyses; 22 for Industry, Including Green Chemical, Product, Manufacturing Process, Waste Stream, Supply Chain, and Student Tutorial Modules: Served on Two Voluntary Advisory Panels – Green Chemicals & Processes Information (NSF/GCI/ANSI 355), and Green Globes Green Building [Risk-Based] Standard

Publications

21 Hazardous Chemical Books
39 Published Technical/Research Manuscripts
18 Authored Reports on the Toxicology of Marihuana for the National Institutes of Mental Health
Authored Thousands of Other Government, Industry, & Academia Research Reports
32 Workshops, Keynote Addresses, & Webinar Presentations
50 Expert Witness Cases

Conferences & Presentations

Organized Two Worldwide Conferences
Organized Two National Conferences
160 Invited Technical Presentations
268 Other Technical Presentations (Abstracts)

Advisory Panels (Invited)

DOD Munitions Emissions Advisory Group Co-Chair, 2000-2005
Greener Chemicals & Processes Information Nat'l. Std. (NSF/GCI/ANSI 355), 2008-2011
Consensus Committee Member; Chemical Characteristics Subcommittee Chairman
Green Building Assessment Nat'l. Std., 2014-2018
Consensus Committee Member, Risk Assessment Subcmte.Tech.Lead, IAQ Subcmte Member

Education

B.S. Oregon State University (Pre-Med)
Ph.D., Toxicology & Psychopharmacology, Oregon State University

Disability/Special Needs Adviser & Counselor

Raised 7 Children, Each with Special Needs
Assisted 48 foster Children & Adults
Developed 300+ PPT Charts for Workshop Presentations
Voluntarily Provide Counseling & Group Workshops in NJ

Workshops, Keynote Addresses, Webinar Presentations, and Whitepapers

"COVID Masks - Scientific Comparison of Various Filtration Inefficiencies," Whitepaper in progress, Nov 2021.

"Dangerous Effects of Everyday COVID Mask Use," Science-based Whitepaper Released to Media, 1 Nov, 2021.

Science-Based Coronavirus Awareness - ***Practical Means to Protect Yourself, Your Home, Employees, and Worksite,*** Public and Multi-Industry Webinar, June, 2020.

"SPF and PU Automated Chemical, Product, Process, and Lifecycle Risk Assessments," Polymers in Building Insulation 2019 Workshop, Dusseldorf, Germany, April 9-10, 2019.

"Lessons Learned from Winning SPF Lawsuits," Spray Polyurethane Foam Alliance Workshop, Daytona Beach FL, Feb 407, 2019

"How to Avoid or Win a Polyurea or SPF Lawsuit," Polyurea Development Association Workshop, Orlando FL, Sept 10-12, 2018.

"SPF Lawsuit Avoidance," *Spray Foam Insider* Podcast May 23, 2018.

"SPF Chemistry Makes It a Safe Product," *Spray Foam Insider* Podcast, May 2, 2018.

Comments on the Product-Chemical Profile for PFASs in Carpets and Rugs, CRI WP, April 16, 2018.

"Increasing SPF Sales by Quantitatively Documenting SPF Non-Risks," Webinar, Feb 21 & 27, 2018.

"SPF Chemistry Makes It A Safe Product," SPFA Conference & Expo, Mobile AL, Jan 29 - Feb 1, 2018.

"Merging Quantitative Risk Assessment Results into An SPF LCA," CPI Technical Conference, New Orleans, October 2-4, 2017.

"GreenSuite® Risk Assessment of Three Spray Polyurethane Systems," CPI Technical Conference, Baltimore, September 25-27, 2016.

"Teaching Toxicology Concepts to Chemists – Web-Based Student Tutorial System for Chemical Hazard, Risk, and Lifecycle Assessments," Webinar, July 12, 18, & August 24 & 29, 2017.

"Chemical Compliance Systems (C-CAS)," Evonik Webinar, June 28, 2017.

"GreenSuite® Green Supply Chain Analytical Compliance System (GSC-ACS)," Industry-Wide Webinar, June 22 & 27, 2017.

"Demonstrating the Integration of Risk Assessment into LCA Using Spray Polyurethane Foam (SPF)," Forum for Sustainability Through Life Cycle Innovation (FSLCI) Webinar, April 26, 2017.

"The Art of Chemical & Product Risk Assessment," Clear Law Institute Webinar, March 20, 2017.

"2016 TSCA Amendment Conformance and GreenSuite® Automated Risk Assessments," Industry–Wide Webinar, January 27 & 31, 2017.

"GreenSuite® Automated Hazard & Risk Alternative Assessments", Stonhard Webinar, July 14, 2016.

"GreenSuite® Automated Hazard & Risk Alternative Assessments", Target Webinar, July 11, 2016.

"A Framework for Integrating Risk Assessments into Social Lifecycle Assessments," 5th International Social LCA Conference, June 13-15, 2016, Harvard, Cambridge, MA.

"Embedding GreenSuite® Risk Assessments into LCA", ProScale/BASF Webinar, April 18, 2016.

"Embedding GreenSuite® Risk Assessments into LCA", ACLCA Webinar, March 30, 2016.

"Risk Assessment of Building Materials", New York Build, March 7, 2016, New York City, NY.

"GreenSuite® Automated Hazard & Risk Alternative Assessments", Industry-Wide Webinar, February 17, 2016

"Science, or Pseudo-Science, in Chemical Risk-Based Decisions" (Keynote Address), Spray Polyurethane Foam Alliance, January 26-29, 2015, Albuquerque, NM.

"ACC Proof-of-Concept Project - GreenSuite® and ConsExpo Integration", American Chemistry Council, November 4, 2014, Washington, D.C. (+ Written Report: January 22, 2015)

"Science, or Pseudo-Science, in Chemical Risk-Based Decisions", Adhesives & Sealants Council, October 20-22, 2014, Greenville, SC.

"Chemicals of Concern," Do I Have Any? Composite Panel Association, September 14-16, 2014, New Orleans, LA.

"Science, or Pseudo-Science, in Chemical Risk-Based Decisions", CCS Internet Workshop, June 16, 2014

"Chemical Homeland Security System (C-HOSS)", American Chemistry Council, October 2, 2012.

Expert Witness Experience

53. 2023 Dec - Present	**"Autism from Potential Lead Exposure"**	**Outcome**: *In Progress*
Case Description: Defense toxicological assessment and analysis of factors that may have contributed to autism supposed diagnoses in two sibling infants with historic blood lead levels, including family genetic factors, parent ages, and potential exposures to other environmental toxicants.		
52. 2023 Feb - Present	**"King SPF Home Contamination Evaluation"**	**Outcome**: *In Progress*
Case Description: Spray Polyurethane Foam (SPF) **plaintiff** toxicological interpretation of indoor air sampling analytical chemistry results and other data. Evaluation for causative chemical identification in indoor air and SPF solid samples and assessment for potential to cause medical injuries. Lawsuit not yet filed.		
51. 2022 Oct - Dec	**"Croff SPF Home Contamination Evaluation"**	**Outcome**: Analyses Completed, Lawsuit Pending
Case Description: Spray Polyurethane Foam (SPF) **plaintiff** toxicological interpretation of indoor air sampling analytical chemistry results. Evaluation for causative chemical identification in indoor air and SPF solid samples and assessment for potential to cause medical injuries.		
50. 2022 Aug	**"Gilliland SPF Potential Health & Exposure Assessment"**	**Outcome**: *Analyses Completed, Lawsuit Pending*
Case Description: Spray Polyurethane Foam (SPF) **plaintiff** indoor air sampling and toxicological interpretation of analytical chemistry results. Evaluation for causative chemical identification in indoor air and SPF solid samples and assessment for potential to cause medical injuries.		
49. 2022 Feb	**"Parent Group v. York (PA) BOE"**	**Outcome**: *Pending Strategy Option Decision(s)*
Case Description: The BOE has mandated COVID mask-wearing in their schools, and the parent group is looking to determine their best strategy for assuring the mandate is lifted permanently for their children. I am currently serving in an advisory capacity and may provide a community workshop, BOE presentation, or serve as a trial expert.		
48. 2022 Jan	**"Parent Group v. Gunnison County (CO) BOE"**	**Outcome**: *Pending Strategy Option Decision(s)*
Case Description: The BOE has mandated COVID mask-wearing in their schools, and the parent group is looking to determine their best strategy for assuring the mandate is lifted permanently for their children. I am currently serving in an advisory capacity and may provide a BOE presentation, or serve as a trial expert.		
47. 2021 Oct	**"Douglas County (Colo.) Schools v. Douglas County Health Department"**	**Outcome**: *Testified Remotely at Hearing 10/25/21*
Case Description: The school district wanted to mandate COVID mask-wearing in schools, but the county health department policy forbid such a school policy. I was asked to testify about the dangers of kids wearing masks for long periods, based upon my scientific research & publication on this topic..		
46. 2021 Aug	**"Baldyga v Energy Spray *SPF* Case"**	**Outcome**: *Settled*
Case Description: Spray Polyurethane Foam (SPF) **defense** case to evaluate medical records, technical reports, depositions, provide SPF formulation quantitative risk assessments and explain SPF chemistry in my expert report		
45. 2021 June - Oct	**"CD MD Shampoo & Conditioner Class Action Arbitrations & Lawsuits"**	**Outcome: *Settled***
Case Description: Multiple plaintiff class action arbitrations and lawsuits against the product manufacturer for false advertising and breach of contract that resulted in similar medical injuries to hundreds of plaintiffs.		
44. 2021 Feb - Present	**"Scott & Sarah Bartolf v CCM Construction"**	**Outcome**: *Settled*
Case Description: Defendant case to analyze and determine if Plaintiff's house was contaminated with bleach, phenol, or chlorophenol used by Defendant to treat four specific, small areas of mold contamination.		
43. 2021 Feb – May	***"Stewart v. Reily & Lapolla " SPF Case***	***Outcome:** Lawsuit Dropped*
Case Description: Spray Polyurethane Foam (SPF) **plaintiff** indoor air sampling and toxicological interpretation of analytical chemistry results. Causative chemical identification in indoor air and SPF solid samples and correlation analysis with medical injuries.		

42. 20 Oct – 2021 Feb	**"Schwartz SPF Foam Removal"**	**Outcome:** *Analyses & Report Completed*
Case Description: Spray Polyurethane Foam (SPF) **defense** case to evaluate medical records, technical reports, depositions, provide SPF formulation quantitative risk assessments.		
41. 2020 Aug – 2022 Dec	***"Kramer v. Midwest Spray Foam et al" SPF Case***	***Outcome: Settled***
Case Description: Spray Polyurethane Foam (SPF) **plaintiff** indoor air sampling and toxicological interpretation of analytical chemistry results. Causative chemical identified in indoor air and SPF solid samples. Medical injuries correlate with known chemical hazardous effects. Give deposition.		
40. 2020 Feb – Present	***"Nicotine Shelf-Life" Case***	***Outcome: Settled***
Case Description: **Plaintiff** case where a large amount of nicotine was imported and a buyer secured access without payment and did not properly store the nicotine. The remaining potency will determine the value.		
39. 2020 Feb – 2020 April	***"Plaintiff v. Insulation of Maine SPF" Case***	***Outcome: Settled***
Case Description: Spray Polyurethane Foam (SPF) **defense** case to evaluate medical records, technical reports, depositions, provide SPF formulation quantitative risk assessments.		
38. 2020 Feb – Present	***"Moyer v. NCFI" SPF Case***	***Outcome:*** *In Progress*
Case Description: Spray Polyurethane Foam (SPF) **defense** case to evaluate medical records, technical reports, depositions, provide SPF formulation quantitative risk assessments.		
37. 2019 Dec – Present	***"Duffy v. McGee et al." SPF Case***	***Outcome:*** *In Appeal*
Case Description: Spray Polyurethane Foam (SPF) **defense** case to evaluate medical records, technical reports, depositions, provide SPF formulation quantitative risk assessments, and to identify alternative exposure scenario.		
36. 2019 Dec – Present	***"DMF Furniture Contamination" Case***	***Outcome:*** *Analyses & Report Completed*
Case Description: **Plaintiff** case where furniture imported from China was treated with dimethyl fumarate which caused several health effects in the family.		
35. 2019 Aug – 2020 March	***"Bruce BAC Homicide" Case***	***Outcome:*** *Transferred to Local Expert*
Case Description: **Defendant** caused a car accident following drinking episode that resulted in the death of the other driver. BAC tests were botched by the laboratory. Defendant expects jail time.		
34. 2019 Jan – Mar 2019	***"Murray SPF Indoor Air Sampling" Case***	***Outcome: Withdrew Complaint***
Case Description: Spray Polyurethane Foam (SPF) **plaintiff** indoor air sampling and toxicological interpretation of analytical chemistry results. No problems identified in indoor air samples. Client decided not to file a complaint.		
33. 2018 Oct –July 2019	***"Bartloft v.Contec" Case***	***Outcome:*** *Settled*
Case Description: Mold remediation defense case to perform a site visit and evaluate indoor air technical reports, chemical literature and product compositions to document that application of bleach and Sporicidin 14 days apart could not cause home contamination nor claimed medical symptoms.		
32. 2018 Sept – Nov	***"Gillooly v. Greenstamp" SPF Case***	***Outcome:*** Withdrew
Case Description: Spray Polyurethane Foam (SPF) **defense** case to evaluate medical records, technical reports, depositions, provide SPF formulation quantitative risk assessments.		
31. 2018 Aug – 2019 Nov	***"Davies v. Natural Polymers" SPF Case***	***Outcome:*** *New Legal Team Hired*
Case Description: Spray Polyurethane Foam (SPF) **plaintiff** case to perform indoor air, SPF and thermal barrier sampling, and identify causative air contaminants from the air, thermal barrier, or heated SPF emissions that could be causing upper respiratory symptoms, nausea, headaches and lethargy. Help develop a remediation option plan		
30. 2018 Aug – Dec	***"O'Neal v. Trojanski" SPF Case***	***Outcome:*** Resolved
Case Description: Spray Polyurethane Foam (SPF) **defense** case to sample, analyze, and ascertain whether toxic SPF residues remained in the substrqte wood after the SPF had been removed. None remained		
29. 2018 May - July	***"Howard v. SPF Installer/Distributor/Manufacturer" Case***	***Outcome:*** Dropped
Case Description: Spray Polyurethane Foam (SPF) **plaintiff** case to identify air contaminants from SPF and/or thermal barrier emissions causing upper respiratory symptoms, and develop response strategy options for the client and develop response strategy options for the client that will change industry		

practices.		
28. 2018 April - June	**"Polise v. SPF Installer/Distributor/Manufacturer" Case**	***Outcome:*** Dropped
Case Description: Spray Polyurethane Foam (SPF) **plaintiff** case to identify air contaminants from SPF or jetliner fuel emissions causing upper respiratory symptoms, and develop response strategy options for the client.		
27. 2017 Aug - Oct	**"Murphy v. Rytech" Case**	***Outcome:*** Dropped
Case Description: *Volatile organic chemical sensitization exascerbation* **plaintiff** case that involved product chemical and toxicological research to identify potential causative agents for plaintiffs recurring respiratory symptoms.		
26. 2016 Dec –2017 Sept	**Commarotto v. Guzzo, Finta, Spray Foam Nation, and Lapolla Industries" SPF Case**	***Outcome:*** Settled
Case Description: Spray Polyurethane Foam (SPF) **defense** case with 4 formulation (1 SPF system) quantitative exposure risk assessments, chemistry process explanation, and demonstration of ingredient toxicity and plaintiff symptom discorrelations, and alternative symptom causation explanations included in my expert report. Provided formal product risk assessment reports (4) and an expert report, followed by a 7 hour deposition that only covered 50% of my report.		
25. 2017 Jan - Mar	**"South Philly Propane v. Airgas East" Case**	***Outcome:*** Settled
Case Description: Toxic tort liability **plaintiff** case resulting from a manufacturer substituting a more hazardous product for a nonhazardous product. Customer now out of business. This case is expected to require my deposition and will likely go to trail.		
24. 2016 Jan- 2016 Dec	**"Bryan & Penny Rice v. Quadrant Chemical Corp.et.al" SPF Case**	***Outcome:*** Settled
Case Description: Spray Polyurethane Foam (SPF) **defense** case with 4 formulation (1 SPF system) quantitative exposure risk assessments, chemistry process explanation, and demonstration of ingredient toxicity and plaintiff symptom discorrelations, and alternative symptom causation explanation included in my expert report.		
23. 2015 July - 2017 Mar	**"Anchor Insulation v. Richard & Monica Beyer" SPF Case**	***Outcome:*** Personal Injury Summary Judgment; Property Damage Award only $89/$400K *Sought*
Case Description: Spray Polyurethane Foam (SPF) **defense** case with 9 formulation (3 SPF systems) quantitative exposure risk assessments, chemistry process explanation, demonstration of ingredient toxicity and plaintiff symptom discorrelations, and alternative symptom causation explanation included in my expert report. This case required my deposition and trial testimony,		
22. 2006 Sept- 2015 July	**"DSM Food Specialties" Case**	***Outcome:*** Settled.
Case Description: Microwave popcorn butter flavoring **defense** case with deposition, expert witness report, regulatory compliance, and scientific literature reviews with bi-weekly verbal reports. This case was settled before I completed my expert report.		
21. 2014 March –2015 May	**"Joann Haney v. Christopher Rhody, MD, West Penn Allegheny Health System, George Schmieler, MD, and The Washington Hospital" Case**	***Outcome:*** Settled.
Case Description: Pepper spray employee training exposure **defense** case with deposition, expert witness report, regulatory compliance, and scientific literature reviews incorporated into my expert report.		
20. 2013 Oct – 2014 Oct	**"Leyo v. Norfolk Southern & Conrail" Case**	***Outcome:*** Settled
Case Description: **Plaintiff** case involving chronic employee exposure to numerous railroad maintenance chemicals that resulted in the death of this employee from colon cancer. My root cause analysis expert report included identification of causative chemicals, detailed explanation of their cancer causation mechanisms, documented workplace exposure pathways, and correlation of the plaintiff's cancer with scientifically proven colon cancer from specific chemicals in the workplace.		
19. 2013 Oct – 2014 Oct	**"Lytle v. Norfolk Southern and Conrail" Case**	***Outcome:*** Settled
Case Description: **Plaintiff** case involving chronic employee exposure to numerous railroad maintenance chemicals that resulted in the death of this employee from rectal/colon adenocarcinoma and liver cancer. My root cause analysis expert report included identification of causative chemicals, detailed explanation of their cancer causation mechanisms, documented workplace exposure pathways, and correlation of the plaintiff's cancer with scientifically proven rectal/colon adenocarcinoma and liver cancer from specific chemicals in the workplace.		

18. 2013 Oct – 2014 Oct	**"Musselman v. Norfolk Southern and Conrail" Case**	***Outcome:*** Settled
Case Description: **Plaintiff** case involving chronic employee exposure to numerous railroad maintenance chemicals that resulted in the death of this employee from kidney carcinoma. My root cause analysis expert report included identification of causative chemicals, detailed explanation of their cancer causation mechanisms, documented workplace exposure pathways, and correlation of the plaintiff's cancer with scientifically proven kidney carcinoma from specific chemicals in the workplace.		
17. 2013 Oct – 2014 Oct	**"Bream v. Norfolk Southern/Conrail/Penn Central" Case**	***Outcome:*** Settled
Case Description: **Plaintiff** case involving chronic employee exposure to numerous railroad maintenance chemicals that resulted in this employee developing lung and kidney cancer. My root cause analysis expert report included identification of causative chemicals, detailed explanation of their cancer causation mechanisms, documented workplace exposure pathways, and correlation of the plaintiff's cancer with scientifically proven lung and kidney cancer from specific chemicals in the workplace.		
16. 2013 Oct – 2014 Oct	**" Larry Archey v. Conrail" Case**	***Outcome:*** Settled
Case Description: **Plaintiff** case involving chronic employee exposure to numerous railroad maintenance chemicals that resulted in this employee developing debilitating lung fibrosis. My root cause analysis expert report included identification of causative chemicals, detailed explanation of their cancer causation mechanisms, documented workplace exposure pathways, and correlation of the plaintiff's lung fibrosis with scientifically proven lung fibrosis from specific chemicals in the workplace.		
15. 2013 Oct – 2014 Oct	**"McConnell v. Norfolk Southern/Conrail/Penn Central" Case**	***Outcome:*** Settled
Case Description: **Plaintiff** case involving chronic employee exposure to numerous railroad maintenance chemicals that resulted in the death of this employee from colon and biliary cancer. My root cause analysis expert report included identification of causative chemicals, detailed explanation of their cancer causation mechanisms, documented workplace exposure pathways, and correlation of the plaintiff's colon and biliary cancer with scientifically proven colon and biliary cancer from specific chemicals in the workplace.		
14. 2013 Oct – 2014 Oct	**"Andrews- PCB v. Norfolk Southern/Conrail/Penn Central" Case**	***Outcome:*** Settled
Case Description: **Plaintiff** case involving chronic employee exposure to numerous railroad maintenance chemicals that resulted in the death of this employee from colon and biliary cancer. My root cause analysis expert report included identification of causative chemicals, detailed explanation of their cancer causation mechanisms, documented workplace exposure pathways, and correlation of the plaintiff's cancer.		
13. 2010 July – 2010 Sept	**"Doruk-Olsen v. Atlantic Associates et al**	***Outcome:*** Settled
Case Description: **Plaintiff** case where an infant suffered a caustic chemical burn on his face that left permanent discoloration as a result of negligent transporting and handling of a hazardous chemical. My expert report included a review of case documents and pertinent scientific effects resulting from exposure to this chemical, and I provided a deposition. However, the case was settled the day before was scheduled to testify.		
12. 2010 May-2010 Aug	**"Hamblin v. British Airways"" Case**	***Outcome:*** Settled
Case Description: **Defendant** case where an airplane passenger was exposed to hydraulic fluid vapors from a front wheel collapsing upon landing, and smoke that allegedly resulted in PTSD and chronic respiratory impairment. I provided an expert report that included analysis of the hydraulic fluid formulation, chemicals of concern, their known toxic effects, and his exposure pathway analysis. I gave a deposition in this case, before it settled.		
11. 2008 Mar - May	**"Segundo Orelanna v. Demert Brands, Borowide Recycling Corp, Central Transport,Inc., Assured Packaging Inc." Case**	***Outcome:*** Settled
10. 2005 Sept – 2007 Sept	**"George & Koula Neamonitis v. SS Anargyroi Taxiarchis, Kingsford Manufacturing Co. et al." Case**	***Outcome:*** Settled
Case Description: Material Safety Data Sheet Evaluations		
9. 2005 April-2005 May	**"Doherty v. Carlisle Syntec; Stephan; Bayer Pharmaceutical" Case**	***Outcome:*** Settled
Case Description: Document review and analysis.		
8. 2004 June- 2005 June	**"Mildred Millangue vs. Jeneric/Pentron Corp." Case**	***Outcome:*** Settled
Case Description:		
7. 2004 July -2004 Oct	**"Jane Doe v. Defendant" Case**	***Outcome: Case Dropped by Plaintiff***
Case Description: Industrial chemicals as possible causative agents for brain tumors.		

6. 2004 July - Sept	**"Margret Simon v. Pentron Corporation" Case**	***Outcome:*** Settled
Case Description: Product research and MSDS.		
5. 2003 Feb-2004 Feb	**"Frances Crangle et al. vs. Hudson County et al." Case**	***Outcome:*** Settled.
4. 2003 July – 2004 Oct	**" Mancini v. Defendant" Case**	***Outcome:*** Settled
Case Description:		
3. 2001 Dec – 2003 Mar	**"Toomey vs. Lime-A-Way, et al." Case**	***Outcome:*** Settled.
Case Description: Product Mislabeling Negligence.		
2. 1998 July-1998 Dec	**"Sylvina v. Salk Institute" Case**	***Outcome:*** Plaintiff awarded $6M
Case Description: Plaintiff wrongful discharge case in which I provided the case strategy, a case analysis chart used for the opening statement to the jury, the management analysis chart used as the closing statement, and management expert testimony that won the veterinarian plaintiff $6M.		
1. 1998 June – Aug 2000	**"Powell Duffry v. Rayonier, Inc. et al" Case**	***Outcome:*** Summary Judgment – Saved $65M
Case Description: **Defendant case for the owner of a large liquid chemical storage tank farm was sued for negligence following a fire at the storage depot. My critique of plaintiff expert witness reports resulted in both being disallowed by the judge.**		

Toxicology Studies of Marihuana Active Chemical Constituents

Conducted by George R. Thompson, Ph.D. and Associates

While Employed at the Mason Research Institute, Worcester MA
18 Reports Submitted to the National Institutes of Mental Health

1. **Acute Toxicity of Δ^9- and Δ^8-Tetrahydrocannabinol after Single Oral and Intravenous Doses to Rats, Monkeys and Dogs,** George R. Thompson and Ulrich H. Schaeppi (September 17, 1970).

2. **Subacute Toxicity of Δ^9-Tetrahydrocannabinol after Eleven Consecutive Daily Treatments in Two Monkeys,** George R. Thompson, Ulrich H. Schaeppi (November 20, 1970).

3. **Toxicity Observed in Fischer Rats Treated Per Os for Five Consecutive Days with Δ^9-Tetrahydrocannabinol,** George R. Thompson, Ulrich H. Schaeppi and Marcus M. Mason (December 18, 1970).

4. **Toxicity Observed in Rhesus Monkeys Treated Per Os for Seven Consecutive Days with Large Doses of Δ^9- or Δ^8-Tetrahydrocannabinol,** George R. Thompson and Ulrich H. Schaeppi (January 12, 1971).

5. **Toxicity Observed in Fischer Rats Treated Per Os for Five Consecutive Days With Δ^8-Tetrahydrocannabinol,** George R. Thompson, Ulrich H. Schaeppi, Marcus M. Mason (January 29, 1971).

6. **Toxicity Observed in Fischer Rats Treated Per Os for Five Consecutive Days With Cannabis Extract,** George R. Thompson, Ulrich H. Schaeppi, Marcus M. Mason (February 10, 1971).

7. **Toxicity Observed in Fischer Rats Treated Per Os for 28 Consecutive Days With Δ^9-Tetrahydrocannabinol,** George R. Thompson, Ulrich H. Schaeppi, Marcus M. Mason (April 5, 1971).

8. **Toxicity of Δ^9-THC After 28 Daily Treatments in Rhesus Monkeys,** George R. Thompson, Robert W. Fleischman, Ulrich H. Schaeppi (April 16, 1971).

9. **Toxicity Observed in Fischer Rats Treated for 28 Consecutive Days With Δ^8-Tetrahydrocannabinol,** George R. Thompson, Marcus M. Mason, Ulrich H. Schaeppi, Harris R. Rosenkrantz (April 23, 1971).

10. **Toxicity Observed in Fischer Rats Treated Per Os for 28 Consecutive Days with Crude Marihuana Extract,** G.R. Thompson, M.M. Mason, Ulrich H. Schaeppi, Harris Rosenkrantz (May 21, 1971).

11. **Toxicity in Rats, Dogs and Monkeys after Acute Administration of Δ^9-Tetrahydrocannabinol and Crude Marihuana Extract,** G.R. Thompson, M.M. Mason, R.W. Fleischman, H. Rosenkrantz and U.H. Schaeppi (June 25, 1971).

12. **Hemolytic Activity of Potential Marihuana Vehicles,** H. Rosenkrantz and G.R. Thompson (July 16, 1971).

13. **Toxicity of Δ^9-THC after 91 Daily Oral Treatments in Rhesus Monkeys,** George R. Thompson, Charles G. Hammann, Robert W. Fleischman, Ulrich H. Schaeppi, Harris Rosenkrantz (August 6, 1971).

14. **Toxicity Observed in Fischer Rats Treated Per Os for 119 Consecutive Days With Δ^9-Tetrahydrocannabinol,** G.R. Thompson, M.M. Mason, U.H. Schaeppi and H. Rosenkrantz (August 20, 1971).

15. **Toxicity Observed in Fischer Rats Treated Per Os for 119 Consecutive Days With Δ^8-Tetrahydrocannabinol,** G.R. Thompson, M.M. Mason, U.H. Schaeppi and H. Rosenkrantz (September 10, 1971).

16. **Irritation Study in Rabbits for Evaluating Subcutaneous Administration of Δ^9-Tetrahydrocannabinol for 28 Consecutive Days,** H. Rosenkrantz, G.R. Thompson, and R.W. Fleischman (September 13, 1971).

17. **Toxicity Observed in Fischer Rats Treated Per Os for 119 Consecutive Day with Crude Marihuana Extract,** G.R. Thompson, M.M. Mason, U.H. Schaeppi and H. Rosenkrantz (September 24, 1971).

18. **Acute and Subacute Toxicity of Δ^9-Tetrahydrocannabinol Administered Intravenously to Monkeys,** George R. Thompson, Harris Rosenkrantz and Robert W. Fleischman (December 20, 1971).

Detailed Work Experience

PROFESSIONAL EXPERIENCE

1991 – Present

Chemical Compliance Systems, Inc., Lake Hopatcong, NJ

***President/CEO/Toxicologist*:** Assessment of hazardous chemical and product health and safety compliance requirements for industry, academic, hospital and government research and/or product facilities; computerized hazardous chemical systems design and development, including needs assessments, software development/ selection/coordination, customized database implementation and maintenance, hardware selection, and organization integration; unique chemical user requirements (e.g., school districts, graphic arts industry, hospitals, etc.); application of the CCS unique Relational Chemical and Product Database (R–CPD) capabilities to hazardous materials compliance requirements, including label generating systems, materials management reports, hazardous material and waste tracking systems, and health/safety policy specifications; needs analyses to recommend policies/ procedures to improve product safety, employee health, environmental controls, operational efficiency, regulatory compliance and liaison, corporate policies and hazard communication; toxicology testing; safety and health crisis resolution; hazard and risk assessments of raw materials and products; Material Safety Data Sheet (MSDS) development, updating, evaluation, or acquisition; customized employee health, safety and environmental training; laboratory and production facility inspections and audits; and legal advice/ expert witness on hazardous chemical safety and health regulatory and liability issues, OSHA and EPA requirements, as well as technical management liability issues.

1983 – Present

Compliance Innovations, Inc.

The Forum For Scientific Excellence, Inc., Lake Hopatcong, NJ

President and Chief Executive Officer: Development of the largest Relational Chemical and Product Database (R–CPD) in the world (>80M data elements), including >800 state, federal, international regulatory lists, a chemical synonym cross-reference dictionary, an Internet linkage to >1.5M MSDSs/SDSs for >10,000 manufacturers, a suppliers "family tree" for their customers, a normalized chemical "green" database for >29,000 chemicals & their 44 ecological, health and safety hazards; creation of 40 analytical compliance Web-based software systems - 18 for DOD munitions, 22 for industry, including 10 modules in our